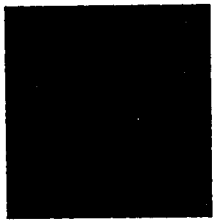
Form A10

(December 2017)



The ACT®

2017 | 2018

In response to your request for Test Information Release materials, this booklet contains the test questions, scoring keys, and conversion tables used in determining your ACT scores. Enclosed with this booklet is a report that lists each of your answers, shows whether your answer was correct, and, if your answer was not correct, gives the correct answer.

If you wish to order a photocopy of your answer document—including, if you took the writing test, a copy of your written essay—please use the order form on the inside back cover of this booklet.

ENGLISH TEST

45 Minutes—75 Questions

DIRECTIONS: In the five passages that follow, certain words and phrases are underlined and numbered. In the right-hand column, you will find alternatives for the underlined part. In most cases, you are to choose the one that best expresses the idea, makes the statement appropriate for standard written English, or is worded most consistently with the style and tone of the passage as a whole. If you think the original version is best, choose "NO CHANGE." In some cases, you will find in the right-hand column a question about the underlined part. You are to choose the best answer to the question.

You will also find questions about a section of the passage, or about the passage as a whole. These questions do not refer to an underlined portion of the passage, but rather are identified by a number or numbers in a box.

For each question, choose the alternative you consider best and fill in the corresponding oval on your answer document. Read each passage through once before you begin to answer the questions that accompany it. For many of the questions, you must read several sentences beyond the question to determine the answer. Be sure that you have read far enough ahead each time you choose an alternative.

PASSAGE I

Ukulele Life

My older sister was a guitar buff and my idol[1] when I was growing up. She would teach me songs on her acoustic guitar now and then after school and on long family road trips to the beach. In those moments, my sister and I were the closest we've ever been. And my guitar itself felt like, well, family.

When my sister left Chicago for college in California, I began carting my guitar around everywhere:[2] to school, to work, to friends houses.[3] Years later, my guitar accompanied me on business trips. No matter where I was,[4] playing it made me feel a little bit closer to home.

1. If the writer were to delete the underlined portion, the paragraph would primarily lose:
   - **A.** an indication that the narrator learned to play guitar at a relatively young age.
   - **B.** an indication of why the narrator became interested in playing the guitar.
   - **C.** a detail that specifies how much older the sister is compared to the narrator.
   - **D.** a detail that reveals the amount of musical talent the narrator's sister had.

2. **F.** NO CHANGE
   G. around. Everywhere,
   H. around everywhere;
   J. around everywhere

3. **A.** NO CHANGE
   B. friend's house's.
   C. friends' houses.
   D. friend's houses.

4. **F.** NO CHANGE
   G. trips and no matter where I was
   H. trips. No matter where I was
   J. trips, no matter where I was,

But one day, after landing in Honolulu, Hawaii, for an extended trip, I couldn't locate my guitar on the luggage carousel. Panicked, I assailed airport [5] personnel, who assured myself [6] that they would try to recover my beloved instrument. At that moment of my extended trip, [7] continuing the trip without it seemed impossible.

My worries began to dissipate, otherwise, [8] as I walked out of the airport and upon [9] the balmy Hawaiian air. In front of me, a man was playing what looked like a miniature guitar. Warm, mellow tones accrued [10] from the instrument, complementing the lyrical rhythm of the Hawaiian words he sang. It was a ukulele.

As soon as I could, I bought a ukulele of my own. I began to linger on [11] the beach, where several native Hawaiians often played. I watched them for hours, my ukulele in my hands, and practiced. Unlike the guitar, which has six strings, my ukulele had four; to make the same chords with the uke, I had to learn completely different finger positions. I also had trouble with dexterity at first because the neck of the uke is much narrower then that of a guitar. [12] I had to retrain my fingers to make smaller movements in order to shape the chords.

5. Which choice best illustrates the fervor with which the narrator communicated with the airport personnel?
   - **A.** NO CHANGE
   - **B.** approached
   - **C.** questioned
   - **D.** contacted

6. **F.** NO CHANGE
   - **G.** whom assured myself
   - **H.** whom assured me
   - **J.** who assured me

7. **A.** NO CHANGE
   - **B.** moment, due to the fact that I was on an extended trip,
   - **C.** very moment during my time in Honolulu,
   - **D.** moment,

8. **F.** NO CHANGE
   - **G.** therefore,
   - **H.** though,
   - **J.** instead,

9. **A.** NO CHANGE
   - **B.** amid
   - **C.** onto
   - **D.** into

10. **F.** NO CHANGE
    - **G.** distributed
    - **H.** appeared
    - **J.** issued

11. **A.** NO CHANGE
    - **B.** Beginning to linger on
    - **C.** Lingering on
    - **D.** On

12. **F.** NO CHANGE
    - **G.** than that of a guitar.
    - **H.** than it.
    - **J.** then it.

When I wasn't working, I was on the beach, losing myself in the bright notes of the uke. Eventually, I began playing music [13] like "He'eia" as [14] the locals.

And the sound of the ukulele is synonymous [15] with the romance and beauty of Hawaii's beaches. [15]

13. Which choice best specifies the type of songs the narrator played on the ukulele?
    - **A.** NO CHANGE
    - **B.** Hawaiian classics
    - **C.** tropical tunes
    - **D.** things

14. **F.** NO CHANGE
    - **G.** through
    - **H.** with
    - **J.** along

15. Which choice best concludes the essay by emphasizing the central point made in the first and second paragraphs?
    - **A.** NO CHANGE
    - **B.** And I couldn't think of a better way to spend my guitarless time in Honolulu.
    - **C.** And although I was guitarless and far from family, I felt like I was home.
    - **D.** And even though I was on a business trip, I didn't want to leave.

PASSAGE II

Hedy Lamarr, Across the Spectrum

In 1940, Hedy Lamarr was becoming a Hollywood star, but she was bored. On set for only three months of the year, she filled her spare time with an unusual hobby: inventing. World War II was underway in Europe, where Lamarr had grown up, and she hoped to invent something to help the Allied cause. Because Lamarr's former husband had often discussed his work in munitions, the actress knew about weaponry.

She had ideas of her own, including an idea of hers (16) for a torpedo with a sophisticated radio-controlled guidance system. [17] Lamarr knew that radio signals on one frequency is easy to jam (18) by anyone sending a competing signal on the same frequency. She envisioned a (19) system that used dozens of frequencies to transmit a signal to guide torpedoes. To protect the signal further, transmitters and receivers would jump from frequency to frequency in a predetermined order that would seem random to an outsider. Such a signal like that would be (20) hard to detect and nearly impossible to disrupt.

[1] In August 1940, Lamarr met composer George Antheil, and the two began collaborating. [2] Antheil, who had synchronized player pianos for his compositions, had the mechanical knowledge that Lamarr needed to instigate (21) her idea. [3] Then in 1942, the inventors heard that the Navy had rejected their idea. [4] They submitted the "Secret Communication System" to the military in June 1941. [5] In the decades after the war, however, (22) the US military discovered the value of Lamarr's idea, which came to be called "spread spectrum," and used it in guidance, radio, and navigation systems. [23]

16. F. NO CHANGE
G. one idea that she had
H. her own idea
J. one

17. At this point, the writer is considering dividing the paragraph into two. Making this change would help organize the essay by separating:

A. an analysis of Lamarr's first invention from details about another one she later developed.
B. information about the origin of Lamarr's idea from details about how the invention would work.
C. an overview of Lamarr's film career from an account of how she conceived of her invention.
D. details about Lamarr's childhood from general information about radio signals.

18. F. NO CHANGE
G. has been easy to jam
H. are easily jammed
J. is easily jammed

19. A. NO CHANGE
B. frequency she envisioned. A
C. frequency, she envisioned a
D. frequency she envisioned; a

20. F. NO CHANGE
G. similar to that would be
H. would be difficult and
J. would be

21. A. NO CHANGE
B. implement
C. discharge
D. uphold

22. F. NO CHANGE
G. war; however,
H. war, however
J. war however

23. For the sake of logic and cohesion, Sentence 3 should be placed:

A. where it is now.
B. before Sentence 1.
C. after Sentence 4.
D. after Sentence 5.

In 1978, spread spectrum was declassified,

and it made a difference. Devices that operate
24

wirelessly, cellular phones, wireless Internet networks,
25

the Global Positioning System—functioning because
26

of Lamarr's idea. It wasn't until 1996 that Lamarr and
27

Antheil, they were finally given credit for spread spectrum.
28

However, they were awarded the Pioneer Award from the
29

Electronic Frontier Foundation. Upon hearing of her award, Lamarr said, "It's about time."

24. Which choice most strongly and specifically emphasizes that the declassification of spread spectrum was a turning point in the history of communication technology?

- **F.** NO CHANGE
- **G.** transformed the communication landscape.
- **H.** had an impact on communications.
- **J.** revolutionized things.

25.
- **A.** NO CHANGE
- **B.** wirelessly—cellular phones,
- **C.** wirelessly: cellular phones,
- **D.** wirelessly, cellular phones

26.
- **F.** NO CHANGE
- **G.** to function
- **H.** function
- **J.** DELETE the underlined portion.

27.
- **A.** NO CHANGE
- **B.** Such
- **C.** This
- **D.** That

28.
- **F.** NO CHANGE
- **G.** Antheil—both finally got
- **H.** Antheil finally to receive
- **J.** Antheil finally received

29.
- **A.** NO CHANGE
- **B.** Conversely, they
- **C.** Anyway, they
- **D.** They

Question 30 asks about the preceding passage as a whole.

30. Suppose the writer's primary purpose had been to give an overview of the history of an important invention. Would this essay accomplish that purpose?

- **F.** Yes, because it recounts the story of Lamarr and Antheil's invention of spread spectrum and the invention's significance.
- **G.** Yes, because it shows how Lamarr and Antheil changed the course of World War II by inventing spread spectrum.
- **H.** No, because although it describes Lamarr and Antheil's invention, it does not establish the importance of spread spectrum.
- **J.** No, because it instead focuses on Lamarr, Antheil, and their collaborations in the film industry.

PASSAGE III

Climbing Mt. Windmill

[1]

They're some 45,000 electricity-generating wind turbines in the United States, and the task of repairing and maintaining these huge machines have represented a substantial undertaking. Ladders inside the towers simplify access to the generators and controllers within the turbine housing. In contrast, servicing the turbine blades those long fiberglass vanes that slice through the air, is a serious challenge.

[2]

[A] Rock climbers are comfortable in high places and capable, equipped with rope and other simple gear, of scaling almost anything. After completing specialized training, rock climbers become ideal "rope technicians."

[3]

When the rope technicians arrive across a turbine, they first lock the blades into a "bunny ears" position, in which two blades angle up and one blade points straight down. The technicians climb the ladder inside the tower, secure themselves with ropes and harnesses, open a hatch in the turbine's housing, and rappel down the vertical blade.

[4]

Certainly, turbine blades withstand severe stress. The blades zip through the elements as fast as 200 miles

31. **A.** NO CHANGE
B. There are
C. Their is
D. There's

32. **F.** NO CHANGE
G. are representing
H. represents
J. represent

33. **A.** NO CHANGE
B. Likewise,
C. Instantly,
D. First,

34. **F.** NO CHANGE
G. blades—those long fiberglass vanes that slice through the air—
H. blades—those long fiberglass vanes that slice through the air,
J. blades, those long fiberglass vanes that slice through the air

35. **A.** NO CHANGE
B. climbing nearly anything—something they're able to do.
C. ascending just about anything by climbing it.
D. using rope to climb almost anything.

36. **F.** NO CHANGE
G. old skills and new knowledge turn rock climbers into ideal "rope technicians."
H. new careers as "rope technicians" open up for rock climbers.
J. ideal "rope technicians" can be made out of rock climbers.

37. **A.** NO CHANGE
B. with
C. via
D. at

per hour, braving heat, hail, blizzards, and more. Yet despite enduring such harsh conditions, most turbine blades that rope technicians service only need a thorough cleaning or other basic upkeep, such as a new coat of paint. [B] Sometimes, the task can be more complicated: patching fiberglass damage from a lightning strike, for example.

[5]

The largest wind turbine blades are (38) over 270 feet long. (38) Technicians work in pairs; (39) while they don't climb in high winds, extreme temperatures, or precipitation. (40) Whether there's lightning within thirty miles, the technicians stay on the ground. [C] Precautions such as these (41)—along with rigorous procedures and training, make (42) the job quite safe.

[6]

For many rock climbers, being a rope technician is a dream job. [D] Fresh air, great vistas, to practice climbing daily, (43) and ample time off to scale actual rocks—it's not a typical job description, is it? (44)

38. Given that all the choices are true, which one would provide the most effective introduction to the paragraph?

- **F.** NO CHANGE
- **G.** The number of wind turbine–related jobs has doubled in five years.
- **H.** A typical wind turbine has about 8,000 parts.
- **J.** Whatever the job, safety is the first priority.

39.

- **A.** NO CHANGE
- **B.** pairs, and
- **C.** pairs,
- **D.** pairs

40.

- **F.** NO CHANGE
- **G.** So that
- **H.** Unless
- **J.** If

41.

- **A.** NO CHANGE
- **B.** these;
- **C.** these,
- **D.** these

42.

- **F.** NO CHANGE
- **G.** is making
- **H.** has made
- **J.** makes

43.

- **A.** NO CHANGE
- **B.** they practice climbing regularly,
- **C.** while often practicing climbing,
- **D.** plenty of climbing practice,

44. The writer wants to end this sentence by emphasizing that rock climbers in particular may find being a rope technician an appealing occupation. Which choice best accomplishes that goal?

- **F.** NO CHANGE
- **G.** what inspires rock climbers to reach such heights?
- **H.** what more could a climber want?
- **J.** ready to sign up yet?

Question 45 asks about the preceding passage as a whole.

45. The writer wants to add the following sentence to the essay:

Enter rock climbers.

The sentence would most logically be placed at:

A. Point A in Paragraph 2.
B. Point B in Paragraph 4.
C. Point C in Paragraph 5.
D. Point D in Paragraph 6.

PASSAGE IV

The following paragraphs may or may not be in the most logical order. Each paragraph is numbered in brackets, and question 59 will ask you to choose where Paragraph 3 should most logically be placed.

Christy's Constitution

[1]

From shoes to chandelier, *Scene at the Signing of the Constitution of the United States* blend [46] accuracy with artistic license to achieve the artist's vision of an event [47] that took place in Philadelphia's Independence Hall. [47] The artist, Howard Chandler Christy, was born in 1873, long after George Washington presided—[48] over the momentous event that in 1787 served the final role of ending [49] the Constitutional Convention.

46. **F.** NO CHANGE
G. have blended
H. are blending
J. blends

47. Which choice best indicates where the painting is on display?

A. NO CHANGE
B. in a way that is not immediately apparent to all who see it on display.
C. in one of the most famous paintings in Washington, DC.
D. on a canvas that has been on display for many decades.

48. **F.** NO CHANGE
G. presided,
H. presided
J. presided;

49. **A.** NO CHANGE
B. ended in the conclusion of
C. finished off
D. concluded

[2]

[1] The group portrait, as big as a billboard, hangs in the US Capitol building, where it was installed in 1940. [2] Christy's prior preparations in advance of the work (50) included a visit to Philadelphia to study how the light falls through the windows in Independence Hall. [3] Christy arranged to see the inkwells into which (51) the quills would have been dipped as the delegates prepared to make history. [4] He scoured countless drawings of period furniture and fabrics, noting (52) color, texture, design.

[5] Hunting (53) down portraits of the signers and scrutinized them. [54]

[3]

Such measures may seem standard in the making of historical paintings, but that is not the case. For example, in Emanuel Luetze's *Washington Crossing the Delaware*, the president strikes a noble pose on a boat. Experts (55) now agree could not have been the vessel that carried the revolutionary leader across the river. In another, painting of the signing (56) of the US Constitution, artist Barry Faulkner places the figures in a Roman ruin.

[4]

Accurate in many respects, Christy's painting also plays with the truth to suggest the grandeur of the moment. For instance, Washington benefits from more

50. **F.** NO CHANGE
G. preparation work leading up to
H. advance preparations preceding
J. preparations for

51. **A.** NO CHANGE
B. which
C. of
D. DELETE the underlined portion.

52. **F.** NO CHANGE
G. of which were noted
H. because they were noted
J. DELETE the underlined portion.

53. **A.** NO CHANGE
B. While hunting
C. As he hunted
D. He hunted

54. The writer wants to add the following statement to the paragraph:

> He deliberately timed his trip for September, the month in which the thirty-nine signers had put their names on the revered document.

This statement would most logically be placed after:

F. Sentence 1.
G. Sentence 2.
H. Sentence 3.
J. Sentence 4.

55. **A.** NO CHANGE
B. boat experts
C. boat; experts
D. boat, experts

56. **F.** NO CHANGE
G. another painting of the signing,
H. another painting of the signing
J. another painting, of the signing

than his share of natural light, which singles him out in Christy's famous painting. Many of the assembled men, luminaries as Benjamin Franklin and James Madison, improbably stare the viewer squarely in the eye. Their expressions suggest they are well aware of their own importance but even more aware of the viewer's, almost as if one more signature will give the document its full meaning.

57. Which choice both supports the claim the writer makes in the preceding sentence about the grandeur of the moment and best emphasizes that Christy deliberately presents Washington as having a special status among the signers?
   - **A.** NO CHANGE
   - **B.** as a hero among heroes.
   - **C.** with visual effects.
   - **D.** in the group.

58.
   - **F.** NO CHANGE
   - **G.** including such luminaries as
   - **H.** who are luminaries
   - **J.** DELETE the underlined portion.

Questions 59 and 60 ask about the preceding passage as a whole.

59. For the sake of logic and cohesion, Paragraph 3 should be placed:
   - **A.** where it is now.
   - **B.** before Paragraph 1.
   - **C.** after Paragraph 1.
   - **D.** after Paragraph 4.

60. Suppose the writer's primary purpose had been to examine how a work of art changed the direction of an artist's career. Would this essay accomplish that purpose?
   - **F.** Yes, because it indicates that Christy led a trend in striving for authenticity in historical paintings.
   - **G.** Yes, because it reveals that a single painting put Christy in the national spotlight.
   - **H.** No, because it focuses on Christy's approach to a particular painting but does not discuss the painting's effect on Christy's career.
   - **J.** No, because it indicates that Christy consistently focused on historical subject matter throughout his career.

PASSAGE V

The Artful Stitch of *Paj Ntaub*

She depicts flowers with layers of petals, intricate spirals and rosettes, teardrops bending within circles, and dizzying mazes of lines—embroidering them in vibrant reds, blues, pinks, yellows, and greens on fabric of delicate silk or cotton. Pang Xiong Sirirathasuk Sikoun is a master of *paj ntaub*, or "flower cloth" embroidery, the most difficult of the century's-oldest Hmong needlework arts.

61. Which choice best maintains the stylistic pattern of descriptions established earlier in the sentence?
   - **A.** NO CHANGE
   - **B.** something with a dizzying effect—
   - **C.** mazes that she creates—
   - **D.** so many lines—

62.
   - **F.** NO CHANGE
   - **G.** centuries-old
   - **H.** centuries'-old
   - **J.** century's-old

Paj ntaub is increasingly made in lighter, softer shades today. [63] She's been creating stitched textiles since she was a young woman, and lived in northern Laos. For the past several decades, she's been designing *paj ntaub* in Philadelphia, Pennsylvania, where she also teaches her craft.

Flower cloth (commonly as a shirt, dress, coat, or collar) is made to be worn as clothing and, depending on the amount of needlework on the piece, is designed either for everyday wear or for a special occasion. With pattern names such as "elephant's foot" and "snail house" and images of animals framed by geometric designs, *paj ntaub* patterns are versatile. What distinguishes *paj ntaub* from other Hmong needlework arts is the artist's use of tiny, tight stitches, and several complex techniques. One technique is reverse appliqué, in which shapes are cut out from, rather than adding on top of, the embroidered fabric.

63. The writer is considering deleting the preceding sentence. Should the sentence be kept or deleted?

- **A.** Kept, because it compares Pang Xiong's embroidery style with that of modern *paj ntaub*.
- **B.** Kept, because it places the subject of the essay in a modern context.
- **C.** Deleted, because it detracts from the paragraph's focus on the various styles of ancient Hmong needlework arts.
- **D.** Deleted, because it adds a detail that is irrelevant to the paragraph's introduction of Pang Xiong's connection to *paj ntaub*.

64.

- **F.** NO CHANGE
- **G.** woman living
- **H.** woman, who lives
- **J.** woman, having lived

65. The best placement for the underlined portion would be:

- **A.** where it is now.
- **B.** after the word *made*.
- **C.** after the word *clothing*.
- **D.** after the word *needlework*.

66.

- **F.** NO CHANGE
- **G.** have been designed
- **H.** are designed
- **J.** design

67. Which choice most clearly builds on the information provided earlier in the sentence about a common theme in *paj ntaub* patterns and images?

- **A.** NO CHANGE
- **B.** only a master artist is able to create *paj ntaub* clothing for special occasions.
- **C.** *paj ntaub* patterns are extraordinarily colorful.
- **D.** *paj ntaub* celebrates the natural world.

68.

- **F.** NO CHANGE
- **G.** tiny tight, stitches
- **H.** tiny, tight stitches
- **J.** tiny tight stitches,

69.

- **A.** NO CHANGE
- **B.** appliqué which
- **C.** appliqué and
- **D.** appliqué,

70.

- **F.** NO CHANGE
- **G.** as an addition
- **H.** to add them
- **J.** added

Another is elaborate overstitching: thousands of layered stitches are applied to its surface. [71]

Pang Xiong regrets that most people she knows today wear only regular [72] clothes. When she was growing up in Laos, she explains, she had few items of clothing, but each garment she owned was handcrafted *paj ntaub*.

However, she still wears flower cloth every day and [73]

would like to inspire others to do so. [74] Pang Xiong teaches *paj ntaub* in art museums—including at the Smithsonian Institution, where some of her textiles are on permanent display—and in community settings around Philadelphia. [75] Pang Xiong is showing a new generation the joys of *paj ntaub* and beautiful handcrafted clothing.

71. **A.** NO CHANGE
B. the surface of the fabric.
C. the surface of it.
D. their surface.

72. The writer is considering revising the underlined portion to the following:

mass-produced

Should the writer make this revision?

F. Yes, because the revision creates a clearer contrast between the homogeneous styles of clothing that are popular today and the handcrafted *paj ntaub*.
G. Yes, because the revision emphasizes Pang Xiong's desire for her handcrafted *paj ntaub* to be sold on a large scale in stores.
H. No, because the original word reinforces the idea that although *paj ntaub* clothing can be used for everyday wear, it should be saved for special occasions.
J. No, because the original word more specifically describes the type of clothing Pang Xiong disapproves of.

73. **A.** NO CHANGE
B. For example, she
C. Besides, she
D. She

74. Which choice most clearly and concisely indicates that Pang Xiong wants other people to wear and appreciate handcrafted clothing?

F. NO CHANGE
G. people to also attempt that approach.
H. people she knows.
J. others.

75. Which of the following true statements, if added here, would best build on the ideas presented in this paragraph and connect to the final sentence of the essay?

A. She loves when people, no matter what their ethnicity, wear traditional clothing every day.
B. She often teaches *paj ntaub* to Hmong adults her age who want to learn new techniques.
C. Recently, she worked with nine young Hmong women in a formal apprenticeship.
D. One of her own favorite pieces tells the story of her family.

END OF TEST 1

STOP! DO NOT TURN THE PAGE UNTIL TOLD TO DO SO.

MATHEMATICS TEST

60 Minutes—60 Questions

DIRECTIONS: Solve each problem, choose the correct answer, and then fill in the corresponding oval on your answer document.

Do not linger over problems that take too much time. Solve as many as you can; then return to the others in the time you have left for this test.

You are permitted to use a calculator on this test. You may use your calculator for any problems you choose, but some of the problems may best be done without using a calculator.

Note: Unless otherwise stated, all of the following should be assumed.

1. Illustrative figures are NOT necessarily drawn to scale.
2. Geometric figures lie in a plane.
3. The word *line* indicates a straight line.
4. The word *average* indicates arithmetic mean.

DO YOUR FIGURING HERE.

1. A marble will be randomly selected from a bag of solid-colored marbles. The probability of selecting a red marble is $\frac{5}{19}$. The probability of selecting a blue marble is $\frac{4}{19}$. What is the probability of selecting a red marble *or* a blue marble?

   A. $\frac{1}{19}$

   B. $\frac{9}{19}$

   C. $\frac{9}{38}$

   D. $\frac{20}{38}$

   E. $\frac{20}{361}$

2. The graph below shows the number of students who were present on Thursday from each of the 5 groups in Ms. Meagan's class. What is the probability that a student selected at random from the class on Thursday is in Group 4 ?

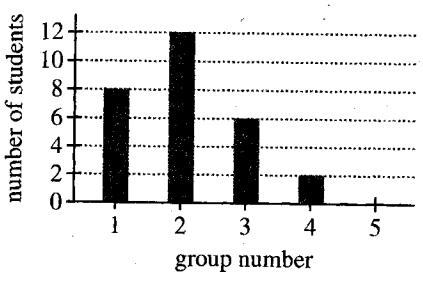
   F. $\frac{1}{28}$

   G. $\frac{1}{14}$

   H. $\frac{1}{5}$

   J. $\frac{1}{4}$

   K. $\frac{1}{2}$



DO YOUR FIGURING HERE.

3. Consider the equation $k = \frac{7}{5}j + 54$. For what value of j is the value of k equal to 40 ?

   A. -10

   B. $-\frac{98}{5}$

   C. $\frac{178}{7}$

   D. $\frac{200}{7}$

   E. 56

4. What is $|3 - x|$ when $x = 8$?

   F. -11
   G. -5
   H. 5
   J. 8
   K. 11

5. When Tyrese fell asleep one night, the temperature was 24°F. When Tyrese awoke the next morning, the temperature was −16°F. Letting + denote a rise in temperature and − denote a drop in temperature, what was the change in temperature from the time Tyrese fell asleep until the time he awoke?

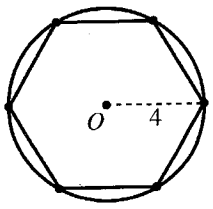
   A. −40°F
   B. −8°F
   C. +4°F
   D. +8°F
   E. +40°F

6. Ming purchased a car that had a purchase price of $5,400, which included all other costs and tax. She paid $1,000 as a down payment and got a loan for the rest of the purchase price. Ming paid off the loan by making 28 payments of $200 each. The total of all her payments, including the down payment, was how much more than the car's purchase price?

   F. $ 200
   G. $1,200
   H. $4,400
   J. $5,600
   K. $6,600

7. Shown below is a regular hexagon inscribed in a circle whose radius is 4 inches. What is the perimeter, in inches, of the hexagon?

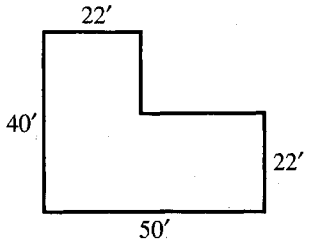
   A. 8π
   B. $12\sqrt{3}$
   C. 18
   D. 20
   E. 24



DO YOUR FIGURING HERE.

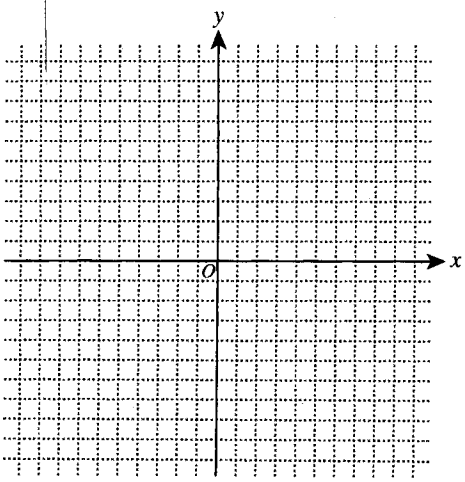
8. The floor plan for an L-shaped storage building is shown below with distances marked in feet. What is the floor area of the building, in square feet?

(Note: Walls in this building meet only at right angles.)



F. 190
G. 504
H. 1,232
J. 1,496
K. 1,980

9. Quadrilateral $ABCD$ with vertices $A(-2,0)$, $B(0,4)$, $C(5,5)$, and $D(8,2)$ will be graphed in the standard (x,y) coordinate plane below.



Which of the following is a type of quadrilateral determined by these vertices?

A. Kite
B. Parallelogram
C. Trapezoid
D. Rectangle
E. Square

10. Given that $f(x) = 3x + 7$ and $g(x) = \frac{x^2}{2}$, what is the value of $f(g(4))$?

F. 8
G. 19
H. 31
J. 152
K. 180.5

DO YOUR FIGURING HERE.

11. At her hot dog stand, Julie sells hot dogs for \$2 each. Purchasing hot dogs and other supplies costs \$200 per month. The solution of which of the following inequalities models the numbers of hot dogs, h, Julie can sell per month and make a profit?

A. $h - 200 > 0$
B. $h - 200 < 0$
C. $h + 200 > 0$
D. $2h - 200 < 0$
E. $2h - 200 > 0$

12. In the standard (x,y) coordinate plane, what is the slope of the line $3x + 8y = 5$?

F. -3
G. $-\frac{3}{8}$
H. $\frac{3}{5}$
J. 3
K. 5

13. Which of the following (x,y) pairs is the solution for the system of equations $x + 2y = 2$ and $-2x + y = 16$?

A. $(-6,4)$
B. $(-1,1.5)$
C. $(1,0.5)$
D. $(0,1)$
E. $(2,0)$

14. On a map, $\frac{1}{4}$ inch represents 16 actual miles. Two towns that are $2\frac{3}{4}$ inches apart on this map are how many actual miles apart?

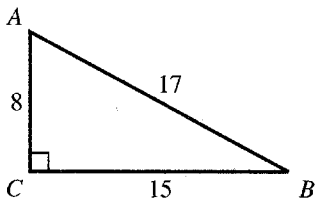
F. 11
G. 16
H. 44
J. 64
K. 176

15. Which of the following matrices is equal to $4\begin{bmatrix} -1 & 2 \\ 0 & -4 \end{bmatrix}$?

A. $\begin{bmatrix} -4 & -8 \end{bmatrix}$
B. $\begin{bmatrix} 4 \\ -16 \end{bmatrix}$
C. $\begin{bmatrix} 3 & 6 \\ 4 & 0 \end{bmatrix}$
D. $\begin{bmatrix} -\frac{1}{4} & \frac{1}{2} \\ 0 & -1 \end{bmatrix}$
E. $\begin{bmatrix} -4 & 8 \\ 0 & -16 \end{bmatrix}$

DO YOUR FIGURING HERE.

16. What is the value of $\tan A$ in right triangle $\triangle ABC$ below?



F. $\frac{8}{17}$

G. $\frac{8}{15}$

H. $\frac{15}{17}$

J. $\frac{15}{8}$

K. $\frac{17}{8}$

17. Tina runs at a rate of 8 miles per hour. At that rate, how many miles will she run in 12 minutes?

A. $\frac{5}{8}$

B. $\frac{2}{3}$

C. $1\frac{1}{2}$

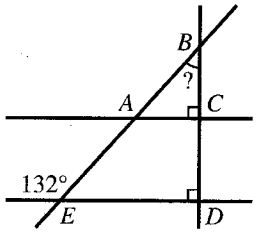
D. $1\frac{3}{5}$

E. 2

18. A function $f(x)$ is defined as $f(x) = -6x^2$. What is $f(-3)$?

F. −324
G. −54
H. 54
J. 108
K. 324

19. In the figure below, A is on $\overleftrightarrow{BE}$ and C is on $\overleftrightarrow{BD}$. What is the measure of $\angle ABC$?



A. 24°
B. 42°
C. 45°
D. 48°
E. 66°

DO YOUR FIGURING HERE.

20. Marcos programs his calculator to evaluate a linear function, but he doesn't say what the function is. When 5 is entered, the calculator displays the value 2. When 15 is entered, the calculator displays the value 6. Which of the following expressions explains what the calculator will display when any number, n, is entered?

F. $\frac{2}{5}n$

G. $\frac{5}{2}n$

H. $n - 3$

J. $n - 9$

K. $\frac{5}{2}n - \frac{21}{2}$

21. On Friday, the temperature at 8:00 a.m. was 49°F and rose at a constant rate of $\frac{1}{2}$°F per hour until noon. A cold front passed through at noon, and the temperature then fell at a constant rate of 1°F per hour. The temperature first fell below 49°F between:

A. noon and 1 p.m.
B. 1 p.m. and 2 p.m.
C. 2 p.m. and 3 p.m.
D. 3 p.m. and 4 p.m.
E. 4 p.m. and 5 p.m.

22. Letter grades in Hugo's math class are based on the percent of the total possible points on 4 unit exams (each worth 100 points) and the final exam (worth 200 points) and are assigned according to the chart below.

Range	Course grade
At least 90%	A
80%–89%	B
70%–79%	C
60%–69%	D
Less than 60%	F

The number of points Hugo scored on the unit exams this term were 82, 88, 91, and 83. When course grades were posted, Hugo's course grade was listed as a B. Which of the following could NOT have been the number of points he scored on the final exam?

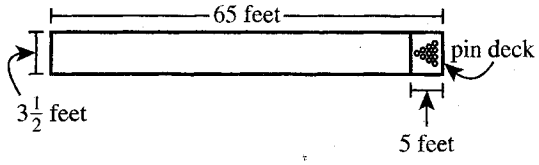
F. 136
G. 156
H. 166
J. 176
K. 196

DO YOUR FIGURING HERE.

Use the following information to answer questions 23–25.

Halle is bowling a series of 3 games. She has bowled 2 of 3 games with scores of 148 and 176. The figure below is a top view of the bowling lane. The dimensions for the bowling lane are given in the figure. The *pin deck* is the rectangular area within the bowling lane where the 10 bowling pins are set up.

(Note: The figure is not drawn to scale.)



23. The diameter of each pin at its base is 2.25 in. When all of the pins are set up, which of the following values is closest to the area, in square inches, that is covered by the bases of the pins?

A. 40
B. 71
C. 111
D. 125
E. 159

24. What is the ratio of the total area of the bowling lane to the area of the pin deck?

F. 12:1
G. 13:1
H. 13:12
J. 127:17
K. 137:17

25. What score will Halle need to earn in her 3rd game to have an average score of 172 for the 3 games?

A. 165
B. 172
C. 182
D. 192
E. 200

---

26. The area of a rectangle is 300 square meters, and its length is 3 times its width. How many meters wide is the rectangle?

F. 10
G. 30
H. 50
J. 100
K. 150

DO YOUR FIGURING HERE.

27. A parallelogram has a perimeter of 96 inches, and 1 of its sides measures 16 inches. If it can be determined, what are the lengths, in inches, of the other 3 sides?

A. 16, 16, 48
B. 16, 24, 24
C. 16, 32, 32
D. 16, 40, 40
E. Cannot be determined from the given information

28. Elmhurst Street is a two-way street. In each direction, it has one 12-foot-wide lane for car traffic, one 6-foot-wide bike lane, and one 8-foot-wide parking lane. How many feet wide is Elmhurst Street?

F. 26
G. 38
H. 52
J. 60
K. 80

29. At Central High School, 4 out of every 10 students ride the bus to and from school, and 3 out of every 8 who ride the bus are freshmen. If there are 2,500 students at Central, how many of the students are freshmen who ride the bus?

A. 375
B. 412
C. 428
D. 561
E. 705

30. If $90° < \theta < 180°$ and $\sin \theta = \frac{20}{29}$, then $\cos \theta = ?$

F. $\frac{29}{20}$
G. $\frac{20}{21}$
H. $-\frac{21}{29}$
J. $-\frac{29}{21}$
K. $-\frac{29}{20}$

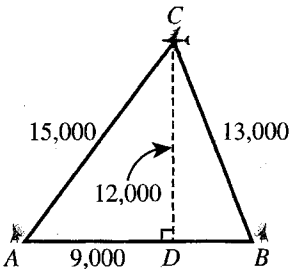
31. Given $f(x) = \frac{2}{x+1}$, what is(are) the real value(s) of t for which $f(t) = t$?

A. -1 only
B. 2 only
C. -2 and 1 only
D. -1 and 2 only
E. 1 and 2 only

DO YOUR FIGURING HERE.

Use the following information to answer questions 32–35.

In the figure below, a highway rest area (at D) and radar stations (at A and B) lie on a level east-west line; A is 9,000 feet due west of D. An airplane (at C) is shown directly above the rest area, flying due west at a constant speed of 300 feet per second and at a constant altitude of 12,000 feet. The airplane is located at a straight-line distance of 15,000 feet from the radar station at A and 13,000 feet from the radar station at B.



32. Which of the following values is closest to the distance, in feet, between the 2 radar stations?

F. 5,000
G. 10,000
H. 10,500
J. 14,000
K. 15,000

33. Let A, C, and D lie in the standard (x,y) coordinate plane such that A is at (0,0) and D is at (9,000, 0). Which of the following equations represents the line along which the airplane is flying?

A. $x = 9{,}000$
B. $x = 15{,}000$
C. $y = 12{,}000$
D. $y = 13{,}000$
E. $y = 15{,}000$

34. Which of the following values is closest to the number of seconds it will take for the airplane to fly from C to the point directly above the radar station at A ?

F. 17
G. 30
H. 40
J. 43
K. 50

DO YOUR FIGURING HERE.

35. When considering the changing triangle formed by A, B, and the moving airplane (C), which of the angles below increases in measure as the airplane flies due west beyond the point directly above A ?

I. $\angle A$
II. $\angle B$
III. $\angle C$

A. I only
B. II only
C. I and II only
D. I and III only
E. II and III only

---

36. Troy made a rectangular poster that is 4 feet long and 2 feet wide. The poster is too large to fit in the available display space, so Troy is going to make a new poster that will have an area that is 50% of the area of the original poster. The length of Troy's new poster will be $\frac{3}{4}$ the length of the original poster. How many feet wide will the new poster be?

F. $\frac{3}{4}$
G. $1\frac{1}{3}$
H. $1\frac{1}{2}$
J. 3
K. 6

37. What is the solution set of the equation $x + 6 = 2(x + 3) - x$?

A. The empty set (no solution)
B. {0}
C. {2}
D. {3}
E. The set of all real numbers

38. Steve plans to use 28 feet of fencing to enclose a region of his yard for a pen for his pet rabbit. What is the area, in square feet, of the largest rectangular region Steve can enclose?

F. 40
G. 45
H. 48
J. 49
K. 196

GO ON TO THE NEXT PAGE.

DO YOUR FIGURING HERE.

39. There are exactly 5 people in a bookstore at 12:00 p.m. Each person earns an annual income that is between \$30,000 and \$35,000. No one enters or leaves the bookstore until 12:15 p.m., when a professional athlete with an annual income of more than \$1,000,000 enters the bookstore and joins the other 5 people. The mean, median, range, and standard deviation of the annual incomes of the 5 people in the bookstore at 12:00 p.m. are calculated and compared to the same 4 statistics of the annual incomes of the 6 people in the bookstore at 12:15 p.m. If it can be determined, which of the 4 statistics changed the least?

A. Range
B. Mean
C. Median
D. Standard deviation
E. Cannot be determined from the given information

40. Ana and Amy started a landscaping job together. When Ana stopped, she had completed $\frac{2}{5}$ of the job. When Amy stopped, she had completed $\frac{1}{3}$ of the job. Then Ruben completed the rest of the job in 2 hours. Assume that Ana, Amy, and Ruben all worked at the same rate. Which of the following values is closest to the number of hours it would have taken 1 of them to complete the entire job alone?

F. 0.37
G. 1.27
H. 2.73
J. 5.00
K. 7.50

41. If a and b are positive real numbers, which of the following is equivalent to $\frac{(2a^{-1}\sqrt{b})^4}{ab^{-3}}$?

A. $8a^2b^4$

B. $\frac{8b^6}{a^4}$

C. $\frac{16b^5}{a^5}$

D. $\frac{16b^4}{a^5}$

E. $\frac{16b}{a^3}$

DO YOUR FIGURING HERE.

42. To become a contestant on a quiz show, a person must correctly order 4 rock stars by age, from youngest to oldest. The contestant knows which one is the oldest rock star, but randomly guesses at the order of the other 3 rock stars. What is the probability the contestant will get all 4 in the correct order?

F. $\frac{1}{24}$

G. $\frac{1}{6}$

H. $\frac{1}{4}$

J. $\frac{1}{3}$

K. $\frac{1}{2}$

43. Which of the following expressions is equivalent to $\frac{\frac{x}{3}+\frac{1}{2}}{\frac{2}{3}-\frac{1}{4}}$?

A. $\frac{-x-1}{5}$

B. $\frac{2x+6}{5}$

C. $\frac{4x+3}{5}$

D. $\frac{4x+6}{5}$

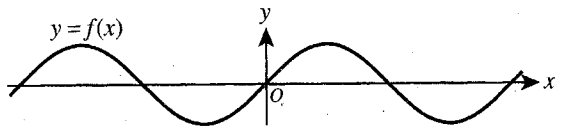
E. $4x+6$

44. An automobile license plate number issued by a certain state has 6 character positions. Each of the first 3 positions contains a single digit from 0 through 9. Each of the last 3 positions contains 1 of the 26 letters of the alphabet. Digits and letters of the alphabet can be repeated on a license plate. How many different such license plate numbers can be made?

F. 36
G. 46,656
H. 1,000,000
J. 12,812,904
K. 17,576,000

DO YOUR FIGURING HERE.

45. The function $y = f(x)$ is graphed in the standard (x,y) coordinate plane below.



The points on the graph of the function $y = 3 + f(x - 1)$ can be obtained from the points on $y = f(x)$ by a shift of:

A. 1 unit to the right and 3 units up.
B. 1 unit to the right and 3 units down.
C. 3 units to the right and 1 unit up.
D. 3 units to the right and 1 unit down.
E. 3 units to the left and 1 unit down.

46. When $\log_5 x = -2$, what is x ?

F. -32

G. -25

H. -10

J. $\frac{1}{10}$

K. $\frac{1}{25}$

47. Which of the following lists those integer values of D for which the fraction $\frac{2}{D}$ lies between $\frac{1}{5}$ and $\frac{1}{3}$?

A. 4 only
B. 3, 4, and 5
C. 8 only
D. 7, 8, and 9
E. 16 only

48. For all real numbers a, b, and c such that $a > b$ and $c < 0$, which of the following inequalities *must* be true?

F. $\frac{a}{c} < \frac{b}{c}$

G. $\frac{a}{c} > \frac{b}{c}$

H. $ac > bc$

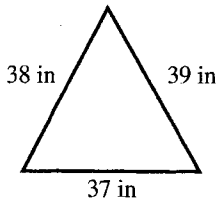
J. $a + c < b + c$

K. $a < b - c$

DO YOUR FIGURING HERE.

49. The triangle shown below has side lengths 37, 38, and 39 inches. Which of the following expressions gives the measure of the largest angle of the triangle?

(Note: For every triangle with sides of length a, b, and c that are opposite $\angle A$, $\angle B$, and $\angle C$, respectively, $c^2 = a^2 + b^2 - 2ab \cos C$.)



A. $\cos^{-1}\left(-\frac{37^2 - 38^2 - 39^2}{2(38)(39)}\right)$

B. $\cos^{-1}\left(-\frac{39^2 - 37^2 - 38^2}{2(37)(38)}\right)$

C. $\cos^{-1}(37^2 - 38^2 - 39^2 + 2(38)(39))$

D. $\cos^{-1}(38^2 - 37^2 - 39^2 + 2(37)(39))$

E. $\cos^{-1}(39^2 - 37^2 - 38^2 + 2(37)(38))$

50. Pete has an average score of exactly x points on 4 equally weighted tests. How many points higher than x must Pete score on the 5th equally weighted test to raise his average score after the 5th test to $x + 2$ points?

F. 2
G. 4
H. 5
J. 8
K. 10

51. The intersection of lines l and m forms the 4 angles $\angle A$, $\angle B$, $\angle C$, and $\angle D$. The measure of $\angle B$ is $3\frac{1}{2}$ times the measure of $\angle A$. Which of the following values is closest to the measure of $\angle A$?

A. 20°
B. 26°
C. 35°
D. 40°
E. 51°

52. A sequence is defined for all positive integers by $s_n = 2s_{(n-1)} + n + 1$ and $s_1 = 3$. What is s_4 ?

F. 9
G. 18
H. 22
J. 49
K. 111

DO YOUR FIGURING HERE.

53. If a is an integer less than -1, which of the following orders the expressions $|a|$, $-a^2$, and $-\frac{1}{a}$ from least value to greatest value?

A. $-\frac{1}{a} < -a^2 < |a|$

B. $-\frac{1}{a} < |a| < -a^2$

C. $|a| < -\frac{1}{a} < -a^2$

D. $-a^2 < |a| < -\frac{1}{a}$

E. $-a^2 < -\frac{1}{a} < |a|$

54. At the school carnival, Ann is playing a game involving a stack of 10 index cards. Each card has a single number written on it: 1 card has a 1, 2 cards have a 2, 3 cards have a 3, and 4 cards have a 4. Ann will choose 1 card at random, and she will be awarded the number of points equal to the number written on the card. Let the random variable X represent the number of points Ann receives on any 1 draw. What is the expected value of X ?

F. 0.4
G. 1
H. 2.5
J. 3
K. 4

55. Which of the following is equivalent to the sum of any 3 consecutive odd integers, x, y, and z, such that $x < y < z$?

A. $3z$

B. $3y$

C. $3x$

D. $3x + 2$

E. $\frac{x+y+z}{3}$

56. The mean of the set of 5 numbers $\{42, 3, 11, 27, x\}$ is 24, and the median of the set of 4 numbers $\{53, 8, 29, y\}$ is 38. If it can be determined, which of the following values is equal to $x - y$?

F. -38
G. -10
H. 10
J. 38
K. Cannot be determined from the given information

DO YOUR FIGURING HERE.

57. Consider all rectangles such that the rectangle's length is greater than the rectangle's width and the length and width are whole numbers of inches. Which of the following perimeters, in inches, is NOT possible for such a rectangle with an area of 144 square inches?

A. 48
B. 60
C. 80
D. 102
E. 148

58. The equation $(x-7)^2+(y-8)^2=10$ is that of a circle that lies in the standard (x,y) coordinate plane. One endpoint of a diameter of the circle has y-coordinate 11. What is the y-coordinate of the other endpoint of that diameter?

F. 1
G. 3
H. 4
J. 5
K. 8

59. The plans for a diving pool call for a rectangular prism that has a length of 30 meters, a width of 25 meters, and a depth of 5 meters. If the plans are changed to increase both the length and the width of the pool by 10%, what will be the increase, to the nearest 1%, in the volume of the pool?

A. 10%
B. 17%
C. 20%
D. 21%
E. 33%

60. One solution of the equation $4x^3-2x^2+x+7=0$ is $x=-1$. Which of the following describes the other 2 solutions?

F. Both are negative real numbers.
G. One is a negative real number, and the other is a positive real number.
H. Both are positive real numbers.
J. One is a positive real number, and the other is a complex number that is not real.
K. Both are complex numbers that are not real.

END OF TEST 2

STOP! DO NOT TURN THE PAGE UNTIL TOLD TO DO SO.

DO NOT RETURN TO THE PREVIOUS TEST.

READING TEST

35 Minutes—40 Questions

DIRECTIONS: There are several passages in this test. Each passage is accompanied by several questions. After reading a passage, choose the best answer to each question and fill in the corresponding oval on your answer document. You may refer to the passages as often as necessary.

Passage I

LITERARY NARRATIVE: This passage is adapted from the short story "Pride" by Alice Munro (©2011 by Alice Munro).

Oneida didn't go to school with the rest of us. She went to a girls' school, a private school. Even in the summers she was not around much. I believe the family had a place on Lake Simcoe.

Oneida was an unusual name. Her father, I believe, called her Ida. Ida's father ran the bank. Even in those days bankers came and went, I suppose to keep them from ever getting too cozy with the customers. But the Jantzens had been having their way in town for too long for any regulations to matter, or that was how it seemed. Horace Jantzen had certainly the look of a man born to be in power. A heavy white beard and a ponderous expression.

In the hard times of the Thirties people were still coming up with ideas. You can be sure, men were nursing a notion bound to make them a million dollars. A million dollars in those days was a million dollars.

It wasn't any railway bum, however, who got into the bank to talk to Horace Jantzen. Who knows if it was a single person or a cohort. Maybe a stranger or some friends of friends. Well dressed and plausible looking, you may be sure. Horace set store by appearances. He wasn't a fool, though maybe not as quick as he should have been to smell a rat.

The idea was the resurrection of the steam-driven car, such as had been around at the turn of the century. Horace Jantzen may have had one himself and had a fondness for them. This new model would be an improved version, of course, and have the advantages of being economical and not making a racket.

I'm not acquainted with the details, having been in high school at the time. But I can imagine the leak of talk and the scoffing and enthusiasm and the news getting through of some entrepreneurs from Toronto or Windsor or Kitchener getting ready to set up locally. Some hotshots, people would say. And others would ask if they had the backing.

They did indeed, because the bank had put up the loan. It was Jantzen's decision and there was some confusion that he had put in his own money. He may have done so, but he had also dipped improperly into bank funds, thinking no doubt that he could pay it back with nobody the wiser. Maybe the laws were not so tight then. There were actually men hired and the old Livery Stable was cleared out to be their place of operations. And here my memory grows shaky, because I graduated from high school, and I had to think about earning a living if that was possible. I settled for bookkeeping, and that meant going out of town to apprentice to an outfit in Goderich. By the time I got back home the steam-car operation was spoken of with scorn by the people who had been against it and not at all by those who had promoted it. The visitors to town who promoted it had disappeared.

The bank had lost a lot of money. There was talk not of cheating but of mismanagement. Somebody had to be punished. Any ordinary manager would have been out on his ear, but given that it was Horace Jantzen this was avoided. What happened to him was almost worse. He was switched to the job of bank manager in the little village of Hawksburg, about six miles up the highway. Prior to this there had been no manager there at all, because they didn't need one. There had just been a head cashier and an underling cashier, both women.

Surely he could have refused, but pride, as it was thought, chose otherwise. Pride chose that he be driven every morning those six miles to sit behind a partial wall of cheap varnished boards, no proper office at all. There he sat and did nothing until it was time for him to be driven home. The person who drove him was his daughter. Sometime in these years of driving she made the transition from Ida to Oneida. At last she had something to do.

If I picture Oneida and her father on these journeys to and from Hawksburg, I see him riding in the back seat, and her in front, like a chauffeur. It may have been that he was too bulky to ride up beside her. I don't see Oneida looking downtrodden or unhappy at the arrangement, nor her father looking actually unhappy. Dignity was what he had, and plenty of it. She had something different. When she went into a store or even walked on the street there seemed to be a little space cleared around her, made ready for whatever she might want or greetings she might spread. She seemed then a bit flustered but gracious, ready to laugh a little at herself or the situation. Of course she had her good bones and

bright looks, all that fair dazzle of skin and hair. So it might seem strange that I could feel sorry for her, the way she was all on the surface of things, trusting.

1. Based on the passage, it could be assumed that the narrator gained the knowledge to tell this story about Jantzen by:
   - **A.** piecing the story together out of hearsay and his own recollections.
   - **B.** learning the details directly from Jantzen.
   - **C.** fabricating the entire story because it didn't really happen.
   - **D.** being a participant in the events as they unfolded.

2. In the context of the passage, which of the following statements most strongly foreshadows Jantzen's downfall?
   - **F.** "Ida's father ran the bank" (line 6).
   - **G.** "In the hard times of the Thirties people were still coming up with ideas" (lines 14–15).
   - **H.** "He wasn't a fool, though maybe not as quick as he should have been to smell a rat" (lines 23–24).
   - **J.** "Horace Jantzen may have had one himself and had a fondness for them" (lines 27–28).

3. The passage suggests that in considering who convinced Jantzen to invest in manufacturing steam-driven cars, most people in town:
   - **A.** could list everyone who was involved.
   - **B.** believed some were friends of friends while others were complete strangers.
   - **C.** figured it had been an old cohort of Jantzen's who had fallen on hard times.
   - **D.** indulged in speculation, but didn't know for sure who it had been.

4. Which of the following is true of people's behavior when the narrator returned to town after his apprenticeship?
   - I. Visitors who promoted steam cars had left town.
   - II. People in town blamed the loss of money on Jantzen having cheated.
   - III. People in town who had favored the plan to bring back steam cars stopped speaking of the cars.
   - IV. People who had been against the plan to bring back steam cars spoke of the cars scornfully.

   - **F.** I and II only
   - **G.** III and IV only
   - **H.** I, III, and IV only
   - **J.** II, III, and IV only

5. Which of the following best paraphrases the narrator's comments in lines 14–16?
   - **A.** People in their thirties had the best ideas for making money.
   - **B.** Because times were hard, people were trying to find new money-making schemes.
   - **C.** Men were making as much as a million dollars a year in the 1930s.
   - **D.** Everyone was sure that they should take their money-making plans to Jantzen.

6. As it is used in line 16, the word *nursing* most nearly means:
   - **F.** rearing.
   - **G.** educating.
   - **H.** healing.
   - **J.** fostering.

7. The narrator speculates that whoever convinced Jantzen to invest in a steam-driven car must have been:
   - **A.** well dressed; Jantzen would have been impressed by someone who looked affluent.
   - **B.** wealthy; otherwise, Jantzen wouldn't have risked loaning the money.
   - **C.** elderly; Jantzen would have trusted someone who could remember the original steam-driven cars.
   - **D.** intelligent; it would have taken someone clever to convince Jantzen to invest.

8. Based on the passage, it's most logical to conclude that the original steam-driven cars were:
   - **F.** expensive and noisy.
   - **G.** reliable and fast.
   - **H.** unattractive and impractical.
   - **J.** luxurious and durable.

9. According to the passage, the majority of the investment money to manufacture a steam-driven car came from:
   - **A.** some of Jantzen's wealthy friends.
   - **B.** Jantzen's entire life savings.
   - **C.** the bank Jantzen was managing.
   - **D.** entrepreneurs from Toronto, Windsor, or Kitchener.

10. The narrator states that people assumed it was pride that drove Jantzen to:
    - **F.** invest in steam-driven cars.
    - **G.** agree to manage the Hawksburg bank.
    - **H.** look miserable while Oneida drove him to work.
    - **J.** create a makeshift office out of varnished boards.

Passage II

SOCIAL SCIENCE: Passage A is adapted from *Plastic: A Toxic Love Story* by Susan Freinkel (©2011 by Susan Freinkel). Passage B is adapted from *American Plastic: A Cultural History* by Jeffrey L. Meikle (©1995 by Jeffrey L. Meikle).

Passage A by Susan Freinkel

Designers were enthralled by the universe of possibility from plastics' earliest days. They loved the design freedom that synthetics offered and the spirit of modernity the materials embodied. To furniture designer Paul T. Frankl, a material like Bakelite, the world's first synthetic plastic, spoke "in the vernacular of the twentieth century . . . the language of invention, of synthesis," and he urged his fellow designers to use their full imaginative powers to explore the new materials' frank artificiality. As interpreted by Frankl and other designers working with Bakelite in the '30s and '40s, that was the language of streamlining, a lingo of curves and dashes and teardrop shapes that created a feeling of speed and motion in everyday objects. Streamline a fountain pen and even that stolid item declared: we're hurtling toward the future here!

There was another reason designers embraced plastics. From the mid-twentieth century on, modern design has been guided by an egalitarian gospel, a belief that good design needn't cost a lot of money, that even the most mundane items could be things of beauty. "Get the most of the best to the most for the least" was the way Ray and Charles Eames put it in their famous tongue-twisting credo. Plastics were the ideal medium for that mission: malleable, relatively inexpensive, and made for mass manufacture.

Yet, as in any new relationship, there were risks. It was all too easy to exploit plastics' powers of mimicry to produce the kinds of imitations—pseudo-wood cabinets and faux-leather recliners—that contributed to the growing reputation of plastic as an inferior material. Plastics' adaptability and glibness undermined their capacity to achieve "dignity" as legitimate materials worthy of being taken seriously, one critic wrote.

This impression was exacerbated by people's unfortunate experiences with plastics in the immediate postwar years. There were plastic plates that melted in hot water, plastic toys that cracked on Christmas morning, plastic raincoats that grew clammy and fell apart in the rain. Polymer technology improved during the 1950s as manufacturers figured out how to make better plastics and, even more important, how to match the right polymer with the right application. But the damage to plastic's reputation had been done.

Passage B by Jeffrey L. Meikle

Worrying about the image of plastic made sense in 1945 when unfamiliar new materials confronted wary consumers. By the mid-1950s, however, no one was ignorant of plastic because it surrounded everyone. Sidney Gross, who joined *Modern Plastics* in 1952 and became editor in 1968, recalled that he had "agitated a lot" over the years to get SPI, the trade association for the plastics industry, to quit trying to convince people "that plastic is not bad." It was a waste of money because plastic's image—good or bad—did not really matter. The key to plastic's success, as he saw it, was always "selling the manufacturer." Once plastic products filled the stores, people had no choice but to consume what they were offered. Most of the time, Gross maintained, after the industry had solved postwar quality problems, plastic objects did work better. Things made of plastic were better designed and lasted longer. People intuitively recognized that fact even if they retained an intellectual notion that plastic was bad or shoddy. In short, nothing succeeded like success.

Often plastic did offer a significant improvement on whatever it replaced. A sleepy householder had to watch only once in disbelief as a polyethylene juice pitcher bounced off the kitchen floor to begin accepting plastic in a practical way no matter how strong the conceptual disdain for it. Even plastic toys, despite the brittle polystyrene items that broke on Christmas morning, proved superior in many ways. A toy soldier of molded polyethylene could not scratch the furniture as readily as an old-fashioned lead soldier. Most people who expressed negative attitudes about plastic used it anyway without thinking about it, either because a particular use had proven itself or because an inexpensive trouble-free alternative no longer existed. As *House Beautiful* observed in 1955, "The news is not that plastics exist, but [that] they have already been so assimilated into our lives." The average person was "conditioned to plastics." They had penetrated so far into the material fabric of everyday life that their presence could not be denied no matter how many people considered them second-rate substitutes or a sad commentary on modern times.

Questions 11–14 ask about Passage A.

11. In the context of Passage A, the author uses the description of a fountain pen (lines 15–16) most nearly to:

- **A.** lament the way that unique objects began to look identical after the advent of streamlining.
- **B.** critique designers for creating items that were beautiful rather than functional.
- **C.** illustrate how even everyday items could be designed to appear modern.
- **D.** exemplify the kind of item that remained largely unaffected by new design trends.

12. The main idea of the second paragraph (lines 17–26) is that plastics:
    - F. appealed to a prevailing philosophy of providing great design to many people for a low cost.
    - G. quickly became popular enough to inspire a number of famous credos and advertising slogans.
    - H. created a challenge for designers, who were not used to working with such a malleable material.
    - J. inspired an artistic movement whose members prized mundane objects rather than beautiful ones.

13. According to Passage A, one reason for designers' early interest in plastics was that:
    - A. the materials' ability to be freely shaped encouraged inventiveness.
    - B. consumers' demand for attractively designed items was high.
    - C. a person creating everyday items out of plastics was seen as a bold risk taker.
    - D. older materials like Bakelite were difficult to work with.

14. It can reasonably be inferred from Passage A that before the 1950s, plastics manufacturers had not yet figured out:
    - F. how to mold plastics to create the impression of streamlining.
    - G. which plastics were best suited to specific purposes.
    - H. whether consumers would buy everyday items made of plastics.
    - J. whether designers would embrace working with plastics.

Questions 15–17 ask about Passage B.

15. In the context of Passage B, the statement "They had penetrated so far into the material fabric of everyday life" (lines 82–83) most nearly refers to the way that plastics came to be:
    - A. considered a symbol of increased consumerism.
    - B. preferred by most consumers to more conventional materials.
    - C. perceived as a threat to traditional ways of life.
    - D. pervasive to the extent that they were integral to people's routines.

16. In Passage B, the primary purpose of the details about the polyethylene juice pitcher (lines 66–70) is to:
    - F. describe an advertisement created by the plastic industry in an attempt to improve plastic's image.
    - G. show how people might be persuaded by plastic's durability despite disliking plastic in general.
    - H. demonstrate how dramatically plastic's quality improved between 1945 and the mid-1950s.
    - J. provide an example of the kinds of mishaps that biased people against plastic.

17. Passage B most nearly suggests that compared to toys made of traditional materials, toys made of plastic were often:
    - A. more flexible and more detailed.
    - B. less costly and sturdier.
    - C. less durable but also less destructive.
    - D. more popular with kids but less popular with parents.

Questions 18–20 ask about both passages.

18. To support their claims about the public's perception of plastics during the time periods discussed in the passages, both passage authors:
    - F. quote people who used or wrote about plastics.
    - G. analyze publications that promoted plastics.
    - H. define key concepts used to market plastics.
    - J. personify artwork or objects made of plastics.

19. Both passages suggest that one bias the public held in the postwar years was that items made of plastic were:
    - A. unattractive in design.
    - B. unnervingly artificial.
    - C. expensive novelties.
    - D. inferior substitutes.

20. Which of the following statements best compares the ways the authors of Passage A and Passage B use details about plastic toys on Christmas morning?
    - F. Passage A uses the toys as an example of good design, while Passage B uses the toys as proof that plastic items were superior to what they replaced.
    - G. Passage A uses the toys to illustrate plastic's popularity, while Passage B uses the toys to illustrate the lack of practical plastic goods.
    - H. Both passages use the toys to show the variety of plastic items produced during the postwar era.
    - J. Both passages use the toys as an example of early problems with plastic's quality.

Passage III

HUMANITIES: This passage is adapted from the article "The Myth of Gabriel García Márquez: How the Colombian Writer Really Changed Literature" by Michael Wood (©2009 by Washington Post.Newsweek Interactive Co. LLC).

Many years later, and many times over, the writer Gabriel García Márquez was to remember the day he discovered how to set about writing his great novel. He was driving from Mexico City to Acapulco when the illumination hit him. He turned the car around, went home, and locked himself away for 18 months. When he reappeared, he had the manuscript of *One Hundred Years of Solitude* in his hands.

When Gerald Martin, around the middle of his rich and resourceful biography of García Márquez, starts to tell this story, the reader may be a little surprised, even disappointed. "He had not been driving long that day when . . . García Márquez, as if in a trance, turned the Opel around, and drove back in the direction of Mexico City. And then . . ." Up to this point, Martin has not been challenging what he calls his subject's "mythomania"—how could he, since it's the basis of the writer's art and fame—but he has not been retelling the myths, either. He has been grounding them, laying out the pieces of what became the puzzles. And that's what he's doing here, too.

After "and then," Martin writes in mock apology, "It seems a pity to intervene in the story at this point but the biographer feels constrained to point out that there have been many versions of this story . . . and that the one just related cannot be true." The truth was no doubt less "miraculous," to use Martin's word. The writer probably continued to Acapulco. He didn't live in total seclusion for 18 months. And García Márquez wasn't starting a new book; he was reviving an old one.

What García Márquez found was a way of telling it. He would combine, as he frequently said, the narrative tone of his grandmother with that of the author Franz Kafka. She told fantastic stories as if they were true, because for her, they were true. Kafka told them that way because he was Kafka. After his moment of illumination García Márquez came more and more to look for (and often to find) the truth in the fantastic, to pursue whatever truth was lurking in the nonliteral reading of literally presented events.

Just because the miracle didn't happen as the story says it did doesn't mean there wasn't a miracle. *One Hundred Years of Solitude* changed García Márquez's life entirely, and it changed literature. When he got into the car to set out for Acapulco, he was a gifted and hardworking writer, certainly. When he got out of the car, he was on his way to the Nobel Prize, which he won in 1982.

García Márquez made many jokes about his fame over the years. These jokes are witty and complicated acts of gratitude for a destiny the writer was sure could have been quite different. One of his finest sentences, written in an article in 1983, concerns a dream of the life he might have led if he had stayed in his isolated birthplace of Aracataca, Colombia. "I would not perhaps be the same person I am now but maybe I would have been something better: just a character in one of the novels I would never have written."

The term "mythomania" certainly covers García Márquez's stories about his life and plenty of his journalism. But his fiction is different. It takes pieces of already thoroughly mythified reality—there is scarcely an extravagant incident in his novels and stories that doesn't have some sort of basis in specific, local fact or legend—and finds the perfect, unforgettable literary home for them. But García Márquez neither copies nor further mythifies these facts and legends. He honors them, to borrow a well-placed word from Martin:

> [O]ver the dark story of conquest and violence, tragedy and failure, he laid the other side of the continent, the carnival spirit, the music and the art of the Latin American people, the ability to honor life even in its darkest corners.

To honor life, I take Martin as saying, is to celebrate dignity, courage, and style wherever they are found and in whatever forms they take. It is not to deny darkness or even to believe it has its compensations.

Martin's biography is itself rather a dark affair—appropriately, since he is telling the life of a man whose autobiography is an elaborate historical myth. In García Márquez's own accounts, his life is both hard and magical. But it's never sad, and Martin evokes the sorrow that must lurk in such a life. There is perhaps a slight imbalance in Martin's insistence on the writer's sadness, an excess of melancholy; but it's a good corrective to García Márquez's own joking cheerfulness and elaborate ironies, and we can return to the master if we get too depressed.

21. The primary function of the first paragraph is to:

- **A.** correct misconceptions about how long it took García Márquez to write *One Hundred Years of Solitude*.
- **B.** describe García Márquez's approach to writing novels.
- **C.** relate a story about García Márquez that Martin discusses in his biography.
- **D.** provide background information about García Márquez's childhood.

22. Based on the passage, which of the following best describes the passage author's opinion of García Márquez's writing?
    - F. He considers García Márquez to be a gifted writer.
    - G. He prefers García Márquez's journalism to García Márquez's novels.
    - H. He thinks García Márquez's novels borrow too heavily from local facts and legends.
    - J. He believes that García Márquez's writing contains excessive melancholy.

23. The "illumination" mentioned in lines 5 and 37 most nearly refers to:
    - A. the realization García Márquez had concerning the approach he should take in writing *One Hundred Years of Solitude*.
    - B. Martin's discovery that García Márquez modeled his writing after Franz Kafka's.
    - C. the passage author's discovery that García Márquez based his stories on local facts and legends.
    - D. the awareness by García Márquez of how miraculous it was that he completed *One Hundred Years of Solitude*.

24. The passage most strongly suggests that a reader might "be a little surprised, even disappointed" (lines 11–12) while reading Martin's book because Martin:
    - F. is critical of García Márquez's preference for writing in seclusion.
    - G. focuses on analyzing the novels of García Márquez rather than discussing his development as a writer.
    - H. interrupts a familiar story about García Márquez to claim that it's not true.
    - J. fails to adequately explain why García Márquez drove back to Mexico City.

25. As it is used in line 24, the word *constrained* most nearly means:
    - A. restrained.
    - B. compelled.
    - C. coerced.
    - D. limited.

26. According to García Márquez, his grandmother told fantastic stories as if they were true because she:
    - F. was imitating Kafka.
    - G. believed they were true.
    - H. hoped to become a successful author.
    - J. had learned the technique from García Márquez.

27. The passage indicates that the comments García Márquez makes about his fame demonstrate his:
    - A. hope that his best work has yet to be written.
    - B. concern that his accomplishments are distorted by others.
    - C. gratitude that his life has unfolded the way it has.
    - D. belief that he deserves more credit for his wit and the complexity of his writing.

28. According to García Márquez, he might have become "something better" (line 57) if he had:
    - F. written *One Hundred Years of Solitude* sooner.
    - G. completed his journey to Acapulco.
    - H. taken his fame less seriously.
    - J. stayed in Aracataca, Colombia.

29. The passage author indicates that Martin's biography helps balance García Márquez's:
    - A. denial that fiction writing is worthy of merit.
    - B. joking cheerfulness and elaborate ironies.
    - C. belief that darkness has its compensations.
    - D. refusal to write about life's tragedies.

30. As it is used in line 87, the word *master* refers to:
    - F. the passage author.
    - G. Martin.
    - H. Kafka.
    - J. García Márquez.

Passage IV

NATURAL SCIENCE: This passage is adapted from the essay "Our Place in the Universe" by Alan Lightman (©2012 by Harper's Magazine Foundation).

One measure of the progress of human civilization is the increasing scale of our maps. A clay tablet dating from about the twenty-fifth century B.C. found near what is now the Iraqi city of Kirkuk depicts a river valley with a plot of land labeled as being 354 *iku* (about thirty acres) in size. In the earliest recorded cosmologies, such as the Babylonian *Enuma Elish*, from around 1500 B.C., the oceans, the continents, and the heavens were considered finite, but there were no scientific estimates of their dimensions. The early Greeks, including Homer, viewed Earth as a circular plane with the ocean enveloping it and Greece at the center, but there was no understanding of scale. In the early sixth century B.C., the Greek philosopher Anaximander, whom historians consider the first mapmaker, and his student Anaximenes proposed that the stars were attached to a giant crystalline sphere. But again there was no estimate of its size.

The first large object ever accurately measured was Earth, accomplished in the third century B.C. by Eratosthenes, a geographer who ran the Library of Alexandria. From travelers, Eratosthenes had heard the intriguing report that at noon on the summer solstice, in the town of Syene, due south of Alexandria, the sun casts no shadow at the bottom of a deep well. Evidently the sun is directly overhead at that time and place. (Before the invention of the clock, noon could be defined at each place as the moment when the sun was highest in the sky, whether that was exactly vertical or not.) Eratosthenes knew that the sun was not overhead at noon in Alexandria. In fact, it was tipped 7.2 degrees from the vertical, or about one fiftieth of a circle—a fact he could determine by measuring the length of the shadow cast by a stick planted in the ground. That the sun could be directly overhead in one place and not another was due to the curvature of Earth. Eratosthenes reasoned that if he knew the distance from Alexandria to Syene, the full circumference of the planet must be about fifty times that distance. Traders passing through Alexandria told him that camels could make the trip to Syene in about fifty days, and it was known that a camel could cover one hundred stadia (almost eleven and a half miles) in a day. So the ancient geographer estimated that Syene and Alexandria were about 570 miles apart. Consequently, the complete circumference of Earth he figured to be about 50×570 miles, or 28,500 miles. This number was within 15 percent of the modern measurement, amazingly accurate considering the imprecision of using camels as odometers.

As ingenious as they were, the ancient Greeks were not able to calculate the size of our solar system. That discovery had to wait for the invention of the telescope, nearly two thousand years later. In 1672, the French astronomer Jean Richer determined the distance from Earth to Mars by measuring how much the position of the latter shifted against the background of stars from two different observation points on Earth. The two points were Paris and Cayenne, French Guiana. Using the distance to Mars, astronomers were also able to compute the distance from Earth to the sun, approximately 100 million miles.

A few years later, Isaac Newton managed to estimate the distance to the nearest stars. (Only someone as accomplished as Newton could have been the first to perform such a calculation and have it go almost unnoticed among his other achievements.) If one assumes that the stars are similar objects to our sun, equal in intrinsic luminosity, Newton asked, how far away would our sun have to be in order to appear as faint as nearby stars? Writing his computations in a spidery script, with a quill dipped in the ink of oak galls, Newton correctly concluded that the nearest stars are about 100,000 times the distance from Earth to the sun, about 10 trillion miles away. Newton's calculation is contained in a short section of his *Principia* titled simply "On the distance of the stars."

Newton's estimate of the distance to nearby stars was larger than any distance imagined before in human history. Even today, nothing in our experience allows us to relate to it. The fastest most of us have traveled is about 500 miles per hour, the cruising speed of a jet. If we set out for the nearest star beyond our solar system at that speed, it would take us about 5 million years to reach our destination. If we traveled in the fastest rocket ship ever manufactured on Earth, the trip would last 100,000 years, at least a thousand human life spans.

31. The overall organization of the passage is best described as a:

- **A.** chronological account of scientists' attempts to determine the distance of the stars from Earth.
- **B.** series of historical examples explaining how increasingly large distances were measured.
- **C.** step-by-step explanation of the calculations used to measure Earth's circumference.
- **D.** collection of anecdotes describing how maps of the universe have changed over time.

32. The main function of the first paragraph is to:

- **F.** list the distances and measurements that were known when Eratosthenes made his calculations.
- **G.** explain what led early geographers to conclude that Earth was curved.
- **H.** demonstrate how humans' sense of their surroundings has expanded over time.
- **J.** summarize contributions the ancient Greeks made to astronomy.

33. Based on the passage, one similarity among the ancient models of the universe described in lines 6–18 is that:
    - **A.** they were based on the assumption that the universe was infinite.
    - **B.** they provided no scientific estimates of the size or scale of the objects they identified.
    - **C.** their depictions of geographical features were surprisingly accurate according to modern maps.
    - **D.** the people who developed them positioned their homelands as the center of the universe.

34. The main idea of the last paragraph is that:
    - **F.** nothing in our experience allows us to relate to the distance from Earth to the nearest stars.
    - **G.** recent advancements in space travel make the distance from Earth to the nearest stars seem small.
    - **H.** the time it would take to travel the distance from Earth to the nearest stars has been calculated only recently.
    - **J.** the nearest stars are more distant from Earth than Newton predicted.

35. According to the passage, the early Greeks imagined Earth as a:
    - **A.** circular plane with the ocean enveloping it and Greece at the center.
    - **B.** giant crystalline sphere to which the stars were attached.
    - **C.** planet tilted 7.2 degrees from the vertical.
    - **D.** plot of land 354 *iku* in size.

36. Based on the passage, to calculate the distance between Syene and Alexandria, Eratosthenes required information about the:
    - **F.** curvature of Earth and the angle of the sun in each city.
    - **G.** number of miles in one hundred stadia and the complete circumference of Earth.
    - **H.** height of the sun at noon in each city and the length of shadows cast on the ground.
    - **J.** time it took camels to travel between the cities and the distance camels could cover in one day.

37. The passage indicates that astronomers could not calculate the distance from Earth to other points in the solar system until:
    - **A.** they had identified proper observation points.
    - **B.** they applied ancient Greek calculations.
    - **C.** the telescope was invented.
    - **D.** Earth and Mars aligned.

38. The passage suggests that compared to his other work, Newton's calculation of the distance to the nearest stars was:
    - **F.** more important.
    - **G.** more speculative.
    - **H.** less complete.
    - **J.** less acknowledged.

39. It can reasonably be inferred from the passage that the author includes the description of Newton's handwriting and writing tools (lines 70–74) primarily to:
    - **A.** highlight how advanced Newton's calculation was by contrasting it with Newton's old-fashioned writing method.
    - **B.** suggest one reason Newton's calculation took so long to decipher.
    - **C.** describe the artistic flourishes of the section of *Principia* in which Newton's calculation appears.
    - **D.** illustrate the number of mistakes Newton made before arriving at the correct calculation.

40. As it is used in line 82, the phrase *set out* most nearly means:
    - **F.** described a vision.
    - **G.** stated a purpose.
    - **H.** started a journey.
    - **J.** created an arrangement.

END OF TEST 3

STOP! DO NOT TURN THE PAGE UNTIL TOLD TO DO SO.

DO NOT RETURN TO A PREVIOUS TEST.

SCIENCE TEST

35 Minutes—40 Questions

DIRECTIONS: There are several passages in this test. Each passage is followed by several questions. After reading a passage, choose the best answer to each question and fill in the corresponding oval on your answer document. You may refer to the passages as often as necessary.

You are NOT permitted to use a calculator on this test.

Passage I

If a gum is added to water (such as the water in a food product), the *viscosity* (resistance to flow) of the resulting aqueous mixture changes. Table 1 shows, for each of 4 gums (Gums W, X, Y, and Z), the viscosity, in centipoise (cP), of a 1.0% by mass aqueous mixture of the gum at 3 temperatures and at 3 resting times. A *resting time* is a period of time an aqueous mixture of a gum sits at rest just after having been prepared.

Table 1

Gum	Temperature (°C)	Viscosity (cP) of a 1.0% aqueous gum mixture at a resting time of: 30 min	75 min	120 min
W	25	4,826	8,300	11,288
	45	3,250	6,825	9,282
	65	2,549	3,849	5,158
X	25	2,562	4,058	5,534
	45	2,100	3,462	4,686
	65	1,640	2,509	3,387
Y	25	1,201	1,994	2,771
	45	781	1,639	2,279
	65	531	802	1,075
Z	25	1,064	1,879	2,668
	45	512	1,562	2,233
	65	384	626	864

Figure 1 shows, for a certain temperature and a certain resting time, how the viscosity of aqueous mixtures of each of the 4 gums varies with gum concentration in percent by mass.

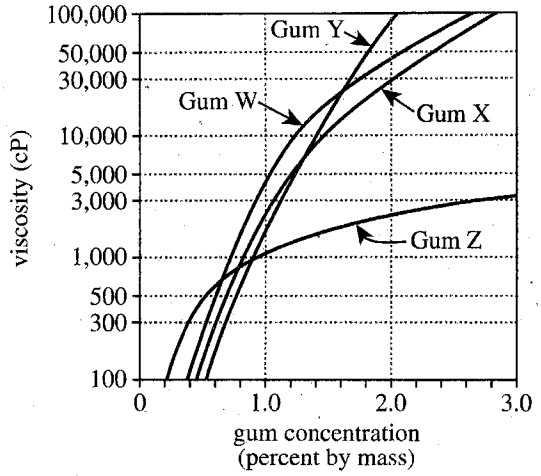
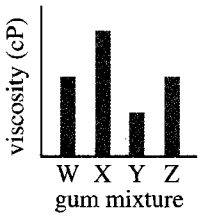


Figure 1

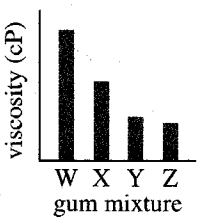
Table and figure adapted from G. O. Phillips and P. A. Williams, eds., *Handbook of Hydrocolloids*, 2nd ed. ©2009 by CRC Press and Woodhead Publishing, Ltd.

1. Based on Table 1, which of the following graphs best compares the viscosities of 1.0% aqueous mixtures of Gums W, X, Y, and Z at 45°C and a resting time of 75 min ?

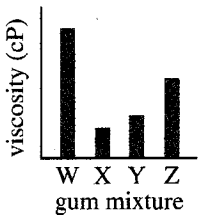
A.



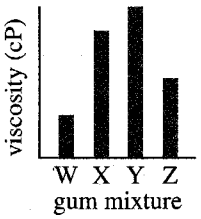
C.



B.



D.



2. Based on Table 1, if a just-prepared 1.0% aqueous mixture of Gum Y is allowed to sit at rest for 100 min at 65°C, its viscosity will most likely be:

F. less than 500 cP.
G. between 500 cP and 800 cP.
H. between 800 cP and 1,100 cP.
J. greater than 1,100 cP.

3. Consider the viscosities shown in Figure 1 for a gum concentration of 2.0%. What is the order of the gums corresponding to those viscosities, from lowest viscosity to highest viscosity?

A. Gum W, Gum Y, Gum X, Gum Z
B. Gum W, Gum Z, Gum X, Gum Y
C. Gum Z, Gum X, Gum W, Gum Y
D. Gum Z, Gum Y, Gum W, Gum X

4. Under the conditions that are the basis for Figure 1, a 1.3% aqueous mixture of which gum has the highest viscosity?

F. Gum W
G. Gum X
H. Gum Y
J. Gum Z

5. Based on Table 1, a 1.0% aqueous mixture of Gum Z at 30°C and a resting time of 75 min would most likely have a viscosity closest to which of the following?

A. 1,250 cP
B. 1,750 cP
C. 2,050 cP
D. 2,350 cP

6. Under the conditions that are the basis for Figure 1, an aqueous mixture of which gum has a viscosity of 100,000 cP at a *lower* concentration than any of the other 3 gums?

F. Gum W
G. Gum X
H. Gum Y
J. Gum Z

Passage II

Biodiesel (BD) is a renewable alternative to traditional petroleum diesel (PD). BD is typically prepared by reacting soybean oil with methanol in the presence of a catalyst, forming compounds called *fatty acid methyl esters* (FAMEs). In contrast, PD contains no FAMEs. The presence of FAMEs in BD causes BD to absorb infrared light differently than does PD. This difference allows pure BD, pure PD, and mixtures of BD and PD to be distinguished by analyzing the absorbance of infrared light.

Students performed 3 studies in which they determined the infrared absorbance characteristics of pure BD, pure PD, and mixtures of BD and PD.

Study 1

The students measured the absorbance, A, of a sample of pure BD and a sample of pure PD at *wavenumbers* from 600 cm^{-1} through 1,800 cm^{-1}. The wavenumber corresponding to a given wavelength is defined as $\frac{1}{\text{the wavelength}}$, where the wavelength is given in cm and the resulting wavenumber is given in cm^{-1}. They plotted the results for each sample (see Figure 1).

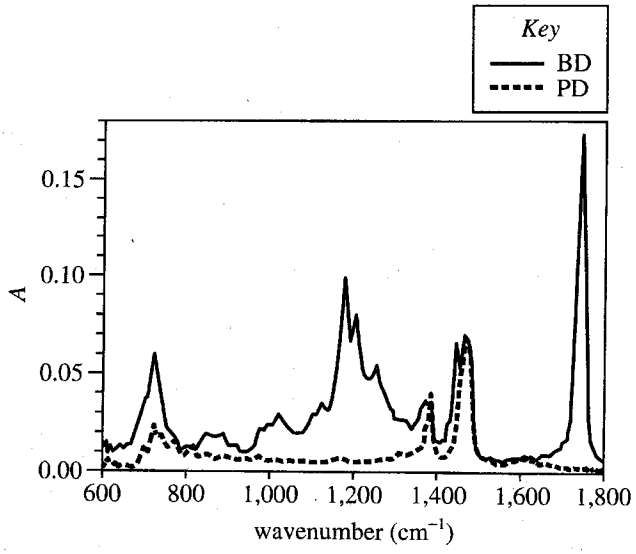


Figure 1

Study 2

The students prepared 7 different mixtures of BD and PD, each containing a different percent by volume of BD. Then, they measured A at 1,746 cm^{-1} for a sample of each of the 7 mixtures, a sample of pure BD, and a sample of pure PD (see Figure 2).

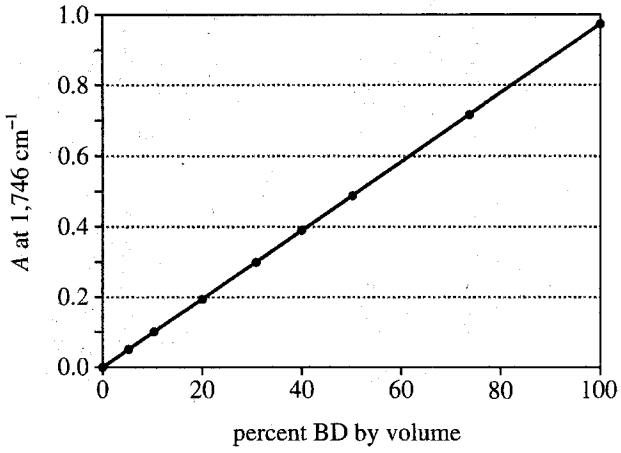


Figure 2

Figures 1 and 2 adapted from A. P. Ault and R. Pomery, "Quantitative Investigations of Biodiesel Fuel Using Infrared Spectroscopy: An Instrumental Analysis Experiment for Undergraduate Chemistry Students." ©2011 by Division of Chemical Education, Inc., American Chemical Society.

Study 3

The students obtained 4 different samples of commercial fuel blends of BD and PD (Samples W–Z). They measured A at 1,746 cm^{-1} for each sample, and then used Figure 2 to calculate the percent BD by volume of each sample (see Table 1).

Table 1

Sample	Percent BD by volume
W	4.0
X	6.0
Y	4.8
Z	4.7

Table 1 adapted from Z. V. Feng and J. T. Buchman, "Instrumental Analysis of Biodiesel Content in Commercial Diesel Blends: An Experiment for Undergraduate Analytical Chemistry." ©2012 by Division of Chemical Education, Inc., American Chemical Society.

7. If the students had tested a 60% BD by volume sample in Study 2, A at 1,746 cm^{-1} would most likely have been:

   A. less than 0.45.
   B. between 0.45 and 0.55.
   C. between 0.55 and 0.65.
   D. greater than 0.65.

8. In Study 2, among the samples tested, as the percent by volume of BD increased, A at 1,746 cm^{-1}:

   F. increased only.
   G. decreased only.
   H. increased and then decreased.
   J. decreased and then increased.

9. Based on the results of Study 2, which fuel sample in Study 3 most likely had the smallest A at 1,746 cm^{-1} ?

   A. Sample W
   B. Sample X
   C. Sample Y
   D. Sample Z

10. The production of BD as described in the passage is best represented by which of the following chemical equations?

    F. FAMEs + catalyst $\rightarrow$ soybean oil + methanol
    G. FAMEs + methanol $\rightarrow$ soybean oil + catalyst
    H. Soybean oil + methanol $\xrightarrow{\text{catalyst}}$ FAMEs
    J. Soybean oil + FAMEs $\xrightarrow{\text{catalyst}}$ methanol

11. Suppose that in Study 1 the students had measured the absorbance at wavenumbers from 600 cm^{-1} through only 1,600 cm^{-1} (instead of through 1,800 cm^{-1}). Based on Figure 1, would the students more likely have measured the absorbance in Study 2 at a wavenumber of 1,172 cm^{-1} or at a wavenumber of 1,464 cm^{-1} ?

    A. A wavenumber of 1,172 cm^{-1}, because PD, but not BD, absorbs strongly at this wavenumber.
    B. A wavenumber of 1,172 cm^{-1}, because BD, but not PD, absorbs strongly at this wavenumber.
    C. A wavenumber of 1,464 cm^{-1}, because PD, but not BD, absorbs strongly at this wavenumber.
    D. A wavenumber of 1,464 cm^{-1}, because BD, but not PD, absorbs strongly at this wavenumber.

12. Consider a sample that contains only FAMEs. Based on the results of Study 1, would the sample more strongly absorb light at a wavenumber of 900 cm^{-1} or light at a wavenumber of 1,250 cm^{-1} ?

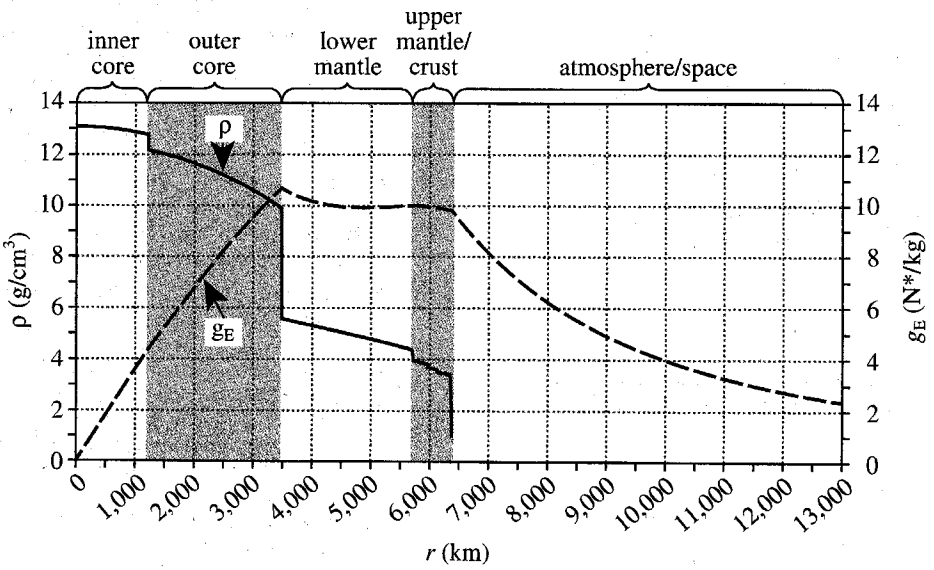
    F. A wavenumber of 900 cm^{-1}; PD contains FAMEs, and PD absorbed more strongly at 900 cm^{-1} than it did at 1,250 cm^{-1}.
    G. A wavenumber of 900 cm^{-1}; BD contains FAMEs, and BD absorbed more strongly at 900 cm^{-1} than it did at 1,250 cm^{-1}.
    H. A wavenumber of 1,250 cm^{-1}; PD contains FAMEs, and PD absorbed more strongly at 1,250 cm^{-1} than it did at 900 cm^{-1}.
    J. A wavenumber of 1,250 cm^{-1}; BD contains FAMEs, and BD absorbed more strongly at 1,250 cm^{-1} than it did at 900 cm^{-1}.

13. Consider the percent BD by volume listed in Table 1 for Sample Y. A 10 liter (L) volume of Sample Y would contain approximately what volume of BD, in liters and in milliliters (mL) ?

	L	mL
A.	0.5	500
B.	0.5	5,000
C.	5	500
D.	5	5,000

Passage III

Earth's gravitational field extends both above and below Earth's surface. In Figure 1, both the value of this field, g_E, and the average density, ρ, of matter within Earth are graphed versus distance, r, from Earth's center. In addition, Figure 1 identifies 5 regions, each of which is located either above or below Earth's surface.



*newtons, a unit of force

Figure 1

Figure 2 shows the percent of Earth's mass located within a given distance r from Earth's center. For example, 10% of Earth's mass is located within 2,300 km of Earth's center, 20% of Earth's mass is located within 2,900 km of Earth's center, and so on.

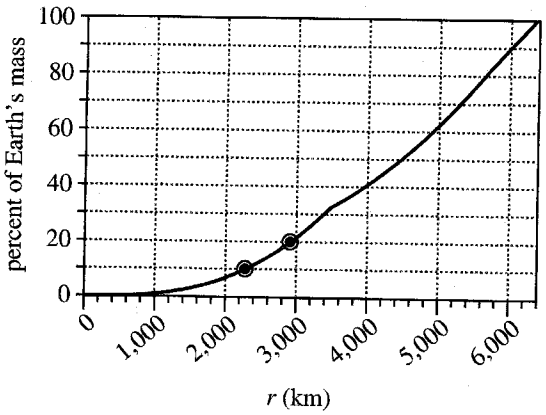


Figure 2

Figures adapted from A. M. Dziewonski and D. L. Anderson, "Preliminary Reference Earth Model." ©1981 by Elsevier B.V.

14. According to Figure 1, which 2 regions are most similar in thickness?

F. The inner core and the outer core
G. The inner core and the upper mantle/crust
H. The outer core and the lower mantle
J. The outer core and the upper mantle/crust

15. According to Figure 2, the innermost 30% of Earth's mass is located between $r = 0$ km and:

A. $r = 3{,}400$ km.
B. $r = 3{,}900$ km.
C. $r = 4{,}500$ km.
D. $r = 5{,}300$ km.

16. Figures 1 and 2 indicate that Earth's radius is approximately:

F. 1,400 km.
G. 3,500 km.
H. 5,700 km.
J. 6,400 km.

17. Based on Figure 1, the approximate value of Earth's gravitational field at $r = 14{,}000$ km is most likely:

A. less than 0.5 N/kg.
B. between 0.5 N/kg and 1.5 N/kg.
C. between 1.5 N/kg and 2.5 N/kg.
D. greater than 2.5 N/kg.

18. On average, Earth's crust is about 30 km thick. Based on Figure 2, the crust accounts for approximately what percent of Earth's mass?

F. 1%
G. 10%
H. 90%
J. 99%

19. Consider 2 hypothetical 1 kg rocks: one located at $r = 2{,}000$ km and the other located at $r = 4{,}000$ km. Based on Figure 1, which of these 2 rocks, if either, more likely weighs *less* ?

A. The rock located at $r = 2{,}000$ km; the value of g_E is less at that location so the rock there has a smaller gravitational force exerted on it.
B. The rock located at $r = 4{,}000$ km; the value of ρ is less at that location so the rock there has a smaller mass.
C. Neither rock; the rocks have identical masses so they have the same weight.
D. Neither rock; the value of g_E is the same for both rocks so they have the same weight.

Passage IV

Biological aging is the process by which the functions within an animal cell gradually decline, causing the cell to age. Four students each proposed an explanation for how this process occurs.

Student 1

Biological aging is caused solely by the *reactive oxygen species* (ROS) produced by cellular respiration. ROS are molecules that damage the proteins and lipids in a cell. A cell produces antioxidants, which eliminate ROS before they cause cell damage. However, the amount of antioxidants produced by a cell is always less than what is needed to eliminate all the ROS produced by that cell. Therefore, ROS damage accumulates in a cell, causing it to age.

Student 2

Biological aging is caused solely by the formation of *cross-links* (a type of chemical bond) between the proteins in a cell, causing these proteins to form clumps. These clumps accumulate in a cell, interfering with the cell's functions, causing it to age. Although ROS is damaging to proteins and lipids, this damage never occurs in a cell because the amount of antioxidants produced by a cell is always greater than what is needed to eliminate all the ROS produced by that cell.

Student 3

Biological aging is caused solely by the DNA damage that results from cell exposure to certain environmental agents. The extent of DNA damage caused by these agents eventually exceeds the cell's ability to repair this damage. Therefore, DNA damage accumulates in a cell, causing it to age. Although cells do produce ROS, ROS damage never accumulates in a cell. While cross-linked proteins do form clumps in a cell, these clumps never affect cell function.

Student 4

Biological aging is caused solely by the *lipofuscin* (a brown pigment made of oxidized lipids) produced by cellular respiration. Lipofuscin forms clumps that accumulate in a cell, interfering with the cell's functions, causing it to age. Although cells do produce ROS, ROS damage never accumulates in a cell. Because protein cross-links are short-lived, protein clumps never accumulate in a cell. The extent of DNA damage that occurs in a cell never exceeds the cell's ability to repair that damage.

20. Which of the students, if any, claimed that biological aging is caused by a substance produced by cellular respiration?

F. Student 1 only
G. Students 1 and 4 only
H. Students 2 and 3 only
J. None of the students

21. Suppose it were determined that the rate of biological aging in an animal cell is directly proportional to the number of chemical bonds formed between the proteins in that cell. This finding would be most consistent with the explanation given by:

A. Student 1.
B. Student 2.
C. Student 3.
D. Student 4.

22. Based on Student 2's explanation, the substances present in cells that are most directly involved with biological aging are composed of what type of subunits?

F. Amino acids
G. Fatty acids
H. Monosaccharides
J. Nucleotides

23. *Carnosine* is a substance that prevents protein cross-linking in animal cells. Which student would be most likely to predict that the average concentration of carnosine in the cells of young adults would be greater than the average concentration of carnosine in the cells of elderly adults?

A. Student 1
B. Student 2
C. Student 3
D. Student 4

24. Which of the students claimed that biological aging occurs because a substance accumulates into clumps that interfere with cellular function?

F. Students 1 and 2 only
G. Students 2 and 4 only
H. Students 1, 3, and 4 only
J. Students 1, 2, 3, and 4

25. Student 1's explanation would be most strongly supported if which of the following observations were made?

A. Increasing the number of protein cross-links in animal cells increases the rate at which those cells age.
B. Decreasing the number of protein cross-links in animal cells increases the rate at which those cells age.
C. Increasing the antioxidant concentration in animal cells increases the rate at which those cells age.
D. Decreasing the antioxidant concentration in animal cells increases the rate at which those cells age.

26. *Compound X* is a chemical that causes genetic mutations in human cells. Suppose it were determined that human neurons grown in the presence of Compound X age at the same rate as human neurons grown in the absence of Compound X. This finding would *weaken* the explanation(s) given by which of the students?

F. Student 2 only
G. Student 3 only
H. Students 1 and 3 only
J. Students 2 and 4 only

Passage V

In a lake, water *leaches* (dissolves out) soluble organic compounds from decaying tree leaves, producing *dissolved organic carbon* (DOC). DOC is subsequently removed from the water if it is *adsorbed* by (becomes adhered to the surface of) clay mineral particles that are suspended in the water. Three studies done at a lake examined DOC adsorption by 3 clay minerals—CM1, CM2, and CM3—found in the lake's sediment.

Green leaves were collected from 5 types of trees around the lake (maple, oak, pine, magnolia, and rhododendron). A 5 L volume of lake water was filtered to remove all solid particles. The following procedures were performed for each type of leaf: A 100 g sample of the leaves was mixed with a 1 L volume of the filtered lake water. The mixture was then placed in the dark for 10 weeks at 4°C while leaching occurred. At 10 weeks, the mixture was filtered to remove all solid particles. The resulting liquid (the *leachate*) was analyzed for DOC.

Study 1

The following procedures were performed for each leachate: A 100 mL volume of the leachate was mixed with 10 g of CM1. The mixture was stirred continuously for 2 hr, then filtered to remove all solid particles. The resulting liquid (the *filtrate*) was analyzed for DOC. The percent of the leachate DOC that had been adsorbed by CM1 was calculated (see Figure 1).

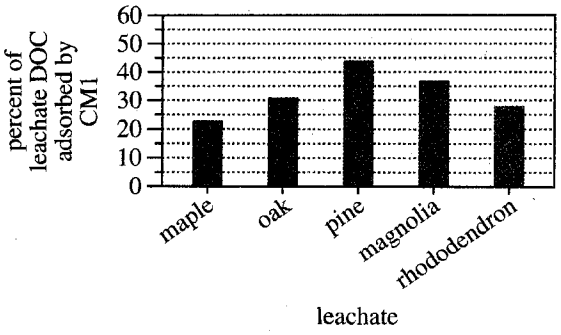


Figure 1

Study 2

Study 1 was repeated, substituting CM2 for CM1 (see Figure 2).

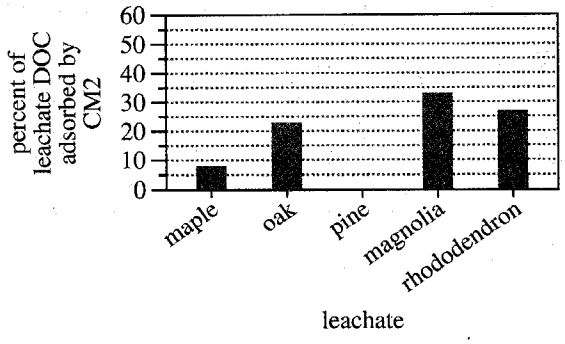


Figure 2

Study 3

Study 1 was repeated, substituting CM3 for CM1 (see Figure 3).

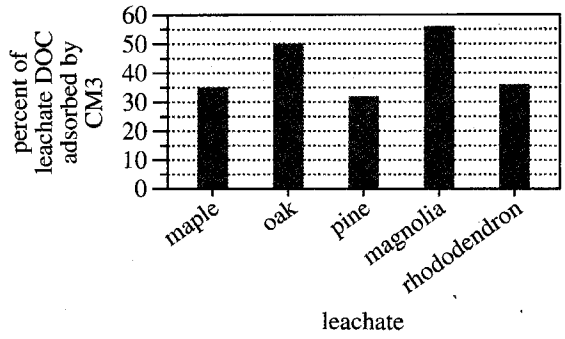


Figure 3

Figures and table adapted from Todd Tietjen, Anssi Vähätalo, and Robert Wetzel, "Effects of Clay Mineral Turbidity on Dissolved Organic Carbon and Bacterial Production." ©2005 by the Swiss Federal Institute for Environmental Science and Technology.

27. According to the results of the studies, from which of the 5 leachates was the greatest percent of DOC adsorbed by CM1, CM2, and CM3, respectively?

	CM1	CM2	CM3
A.	maple	maple	rhododendron
B.	oak	pine	magnolia
C.	pine	magnolia	rhododendron
D.	pine	magnolia	magnolia

28. According to the results of Study 3, the percent of leachate DOC adsorbed by CM3, averaged across the 5 types of leaves, is closest to which of the following?

F. 10%
G. 20%
H. 30%
J. 40%

29. Is the statement "CM2 adsorbed a greater percent of the DOC in the maple leachate than did CM3" supported by the results of Studies 2 and 3 ?

A. Yes; CM2 adsorbed 35% of the leachate DOC, whereas CM3 adsorbed 7%.
B. Yes; CM2 adsorbed 55% of the leachate DOC, whereas CM3 adsorbed 17%.
C. No; CM2 adsorbed 7% of the leachate DOC, whereas CM3 adsorbed 35%.
D. No; CM2 adsorbed 17% of the leachate DOC, whereas CM3 adsorbed 55%.

30. What was the independent (manipulated) variable in each of the 3 studies and what was the independent variable across the 3 studies?

	in each study	across the studies
F.	type of lake water	type of clay mineral
G.	type of leaf leachate	type of clay mineral
H.	volume of leaf leachate	mass of clay mineral
J.	volume of filtrate	mass of leaves

31. According to the results of the studies, which of the 3 clay minerals, if any, reduced the DOC in the oak leachate by more than 50% ?

A. CM1 only
B. CM2 only
C. CM1 and CM3 only
D. None of the 3 clay minerals

32. Is a mixture of any one of the leachates and any one of the clay minerals properly considered a solution?

F. Yes, because the clay mineral particles are dissolved in the leachate.
G. Yes, because the clay mineral particles are not dissolved in the leachate.
H. No, because the clay mineral particles are dissolved in the leachate.
J. No, because the clay mineral particles are not dissolved in the leachate.

33. In lake water, DOC is broken down into simpler compounds by electromagnetic energy in the visible wavelength range. What action was taken in the studies to prevent this process from occurring?

A. Each mixture of leaves and filtered lake water was placed in the dark.
B. Each mixture of filtrate and clay mineral was placed in the dark.
C. Each mixture of leaves and lake water was filtered.
D. Each mixture of leachate and clay mineral was filtered.

Passage VI

Plant roots can respond to a stimulus. Response to light is *phototropism*; response to gravity is *gravitropism*. Growth toward a stimulus is a *positive tropism*; growth away from a stimulus is a *negative tropism*.

For 2 experiments with *wild-type* (WT) and *mutant* (M) *Arabidopsis* seeds, nutrient agar was put into each of 8 petri dishes (PD1–PD8).

Experiment 1

Six WT *Arabidopsis* seeds were placed in each of PD1 and PD2. Six M *Arabidopsis* seeds were placed in each of PD3 and PD4. Then, PD1 and PD3 were placed in the dark for 70 hr, and PD2 and PD4 were exposed to light from above for 70 hr. Figure 1 shows the growth of the *hypocotyls* (seedling stems) above the surface of the nutrient agar and the growth of the *radicles* (seedling roots) below the surface of the nutrient agar in each dish at 70 hr.

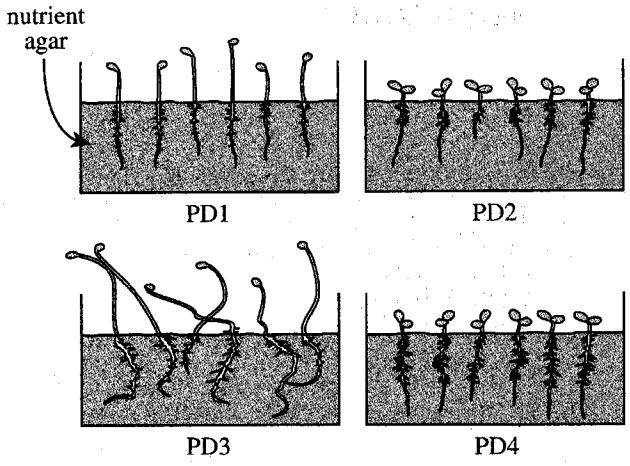


Figure 1

Experiment 2

Six WT *Arabidopsis* seeds were placed in each of PD5 and PD6. Six M *Arabidopsis* seeds were placed in each of PD7 and PD8. Then, PD5–PD8 were exposed to light from above for 70 hr. After 70 hr, each petri dish was turned 90° such that each dish was vertical and the seedlings in each dish were approximately horizontal (see Figure 2).

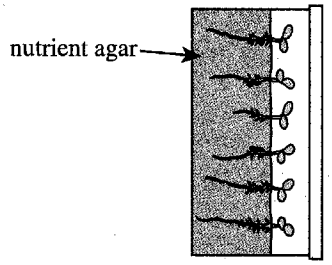


Figure 2

Then, PD5 and PD7 were exposed to light from above for 25 hr while PD6 and PD8 were exposed to light from below for 25 hr. At various times during the 25 hr, the downward curvature, in degrees (°), of the radicle (relative to its starting position) of each seedling in each dish was measured. The average downward curvature of the radicles in each dish at each measurement time is shown in Figure 3.

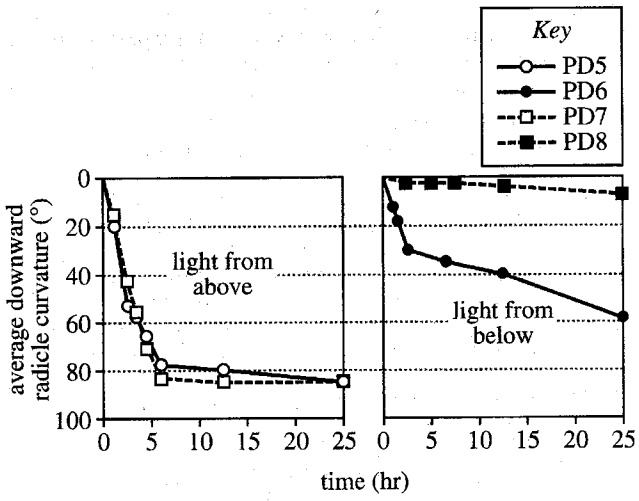
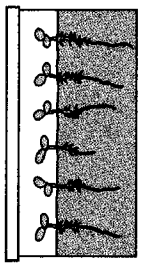


Figure 3

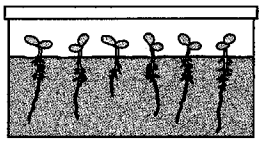
Figures adapted from Stanislav Vitha, Liming Zhao, and Fred David Sack, "Interaction of Root Gravitropism and Phototropism in Arabidopsis Wild-Type and Starchless Mutants." ©2000 by American Society of Plant Physiologists.

34. Which of the following figures best shows the orientation of PD5 before the petri dish was turned 90° ?

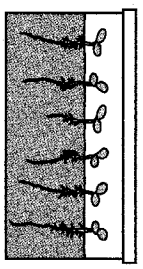
F.



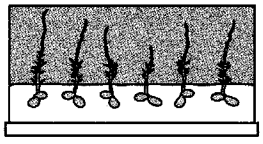
H.



G.



J.



35. PD8 contained the same type of seeds, and was subject to the same growth conditions before being turned 90°, as which petri dish in Experiment 1 ?

A. PD1
B. PD2
C. PD3
D. PD4

36. Based on the results of Experiment 1, in the absence of light, did the radicles of the M *Arabidopsis* seedlings have the same response to gravity as did the radicles of the WT seedlings?

F. No; the variation in the orientation of the radicles in PD3 was greater than that of the radicles in PD1.
G. No; the variation in the orientation of the radicles in PD4 was greater than that of the radicles in PD2.
H. Yes; the variation in the orientation of the radicles in PD3 was the same as that of the radicles in PD1.
J. Yes; the variation in the orientation of the radicles in PD4 was the same as that of the radicles in PD2.

37. During the 25 hr in Experiment 2 that WT *Arabidopsis* seedlings were exposed to light from below, did the hypocotyls of the seedlings more likely exhibit positive phototropism or negative phototropism?

A. Positive, because seedling hypocotyls typically grow away from a light stimulus.
B. Positive, because seedling hypocotyls typically grow toward a light stimulus.
C. Negative, because seedling hypocotyls typically grow away from a light stimulus.
D. Negative, because seedling hypocotyls typically grow toward a light stimulus.

38. Based on the results shown in Figure 1 for PD2, is *Arabidopsis* a monocot or a dicot?

F. Monocot; seedlings have 1 cotyledon.
G. Monocot; seedlings have 2 cotyledons.
H. Dicot; seedlings have 1 cotyledon.
J. Dicot; seedlings have 2 cotyledons.

39. In Experiment 2, each petri dish had how many different orientations?

A. 1
B. 2
C. 3
D. 4

40. To evaluate the effect of light on the growth of WT *Arabidopsis* seedlings, the results for which 2 petri dishes in Experiment 1 should be compared?

F. PD1 and PD2
G. PD1 and PD3
H. PD2 and PD3
J. PD2 and PD4

END OF TEST 4

STOP! DO NOT RETURN TO ANY OTHER TEST.

Scoring Keys for Form A10

Use the scoring key for each test to score your answer document for the multiple-choice tests. Mark a "1" in the blank for each question you answered correctly. Add up the numbers in each reporting category and enter the total number correct for each reporting category in the blanks provided. Also enter the total number correct for each test in the blanks provided. The total number correct for each test is the sum of the number correct in each reporting category.

Test 1: English—Scoring Key

		Reporting Category*		
	Key	POW	KLA	CSE
1.	B	___		
2.	F			___
3.	C			___
4.	F			___
5.	A	___		
6.	J			___
7.	D		___	
8.	H	___		
9.	D			___
10.	J		___	
11.	A			___
12.	G			___
13.	B		___	
14.	H			___
15.	C	___		
16.	J		___	
17.	B	___		
18.	H			___
19.	A			___
20.	J		___	
21.	B		___	
22.	F			___
23.	C	___		
24.	G	___		
25.	B			___
26.	H			___
27.	A			___
28.	J			___
29.	D	___		
30.	F	___		
31.	B			___
32.	H			___
33.	A	___		
34.	G			___
35.	A		___	
36.	F			___
37.	D			___
38.	J	___		

		Reporting Category*		
	Key	POW	KLA	CSE
39.	B			___
40.	J		___	
41.	C			___
42.	F			___
43.	D			___
44.	H	___		
45.	A	___		
46.	J			___
47.	C	___		
48.	H			___
49.	D		___	
50.	J		___	
51.	A			___
52.	F			___
53.	D			___
54.	G	___		
55.	B			___
56.	H			___
57.	B	___		
58.	G			___
59.	A	___		
60.	H	___		
61.	A		___	
62.	G			___
63.	D	___		
64.	G			___
65.	C			___
66.	F			___
67.	D	___		
68.	H			___
69.	A			___
70.	J			___
71.	B			___
72.	F	___		
73.	D	___		
74.	F		___	
75.	C	___		

***Reporting Categories**
POW = Production of Writing
KLA = Knowledge of Language
CSE = Conventions of Standard English

Number Correct (Raw Score) for:	
Production of Writing (POW)	___ (23)
Knowledge of Language (KLA)	___ (12)
Conventions of Standard English (CSE)	___ (40)
Total Number Correct for English Test (POW + KLA + CSE)	___ (75)

Test 2: Mathematics—Scoring Key

Key	Reporting Category*						
	PHM					IES	MDL
	N	A	F	G	S		
1. B					—		—
2. G						—	—
3. A		—					
4. H						—	
5. A						—	—
6. G						—	—
7. E				—			
8. J						—	—
9. C				—			
10. H			—				
11. E						—	—
12. G			—				
13. A		—					
14. K						—	—
15. E	—						
16. J				—			
17. D	—						—
18. G			—				
19. B				—			
20. F			—				—
21. C						—	—
22. K		—					—
23. A						—	—
24. G						—	—
25. D						—	—
26. F		—					
27. C						—	
28. H						—	
29. A						—	
30. H			—				

Key	Reporting Category*						
	PHM					IES	MDL
	N	A	F	G	S		
31. C		—					
32. J				—			—
33. C		—					—
34. G						—	—
35. A				—			—
36. G						—	—
37. E		—					
38. J						—	—
39. C					—		—
40. K						—	—
41. C	—						
42. G					—		—
43. D		—					
44. K					—		
45. A			—				
46. K			—				
47. D						—	
48. F						—	
49. B				—			
50. K					—		
51. D						—	
52. J			—				
53. E	—						
54. J					—		—
55. B						—	
56. G						—	
57. A						—	—
58. J				—			
59. D						—	—
60. K	—						

Combine the totals of these columns and put in the blank for PHM in the box below.

***Reporting Categories**
PHM = Preparing for Higher Math
N = Number & Quantity
A = Algebra
F = Functions
G = Geometry
S = Statistics & Probability
IES = Integrating Essential Skills
MDL = Modeling

Number Correct (Raw Score) for:

Preparing for Higher Math (PHM) (N + A + F + G + S)	_____ (35)
Integrating Essential Skills (IES)	_____ (25)
Total Number Correct for Mathematics Test (PHM + IES)	_____ (60)
Modeling (MDL) (Not included in total number correct for mathematics test raw score)	_____ (26)

Test 3: Reading—Scoring Key

Key	Reporting Category*		
	KID	CS	IKI
1. A		___	
2. H	___		
3. D	___		
4. H	___		
5. B	___		
6. J		___	
7. A	___		
8. F	___		
9. C	___		
10. G	___		
11. C			___
12. F	___		
13. A	___		
14. G	___		
15. D		___	
16. G		___	
17. C	___		
18. F			___
19. D			___
20. J			___

Key	Reporting Category*		
	KID	CS	IKI
21. C		___	
22. F		___	
23. A	___		
24. H			___
25. B		___	
26. G	___		
27. C	___		
28. J	___		
29. B			___
30. J	___		
31. B		___	
32. H		___	
33. B	___		
34. F	___		
35. A	___		
36. J	___		
37. C	___		
38. J	___		
39. A		___	
40. H		___	

***Reporting Categories**
KID = Key Ideas & Details
CS = Craft & Structure
IKI = Integration of Knowledge & Ideas

Number Correct (Raw Score) for:

Key Ideas & Details (KID) _____ (23)

Craft & Structure (CS) _____ (11)

Integration of Knowledge & Ideas (IKI) _____ (6)

Total Number Correct for Reading Test (KID + CS + IKI) _____ (40)

Test 4: Science—Scoring Key

Key	Reporting Category*		
	IOD	SIN	EMI
1. C	___		
2. H	___		
3. C	___		
4. F	___		
5. B	___		
6. H	___		
7. C		___	
8. F	___		
9. A	___		
10. H		___	
11. B		___	
12. J			___
13. A	___		
14. H	___		
15. A	___		
16. J	___		
17. C	___		
18. F	___		
19. A			___
20. G			___

Key	Reporting Category*		
	IOD	SIN	EMI
21. B			___
22. F			___
23. B			___
24. G			___
25. D			___
26. G			___
27. D	___		
28. J	___		
29. C			___
30. G		___	
31. D	___		
32. J		___	
33. A		___	
34. H		___	
35. D		___	
36. F			___
37. B			___
38. J			___
39. B		___	
40. F		___	

***Reporting Categories**
IOD = Interpretation of Data
SIN = Scientific Investigation
EMI = Evaluation of Models, Inferences & Experimental Results

Number Correct (Raw Score) for:

Interpretation of Data (IOD) _____ (17)

Scientific Investigation (SIN) _____ (10)

Evaluation of Models, Inferences & Experimental Results (EMI) _____ (13)

Total Number Correct for Science Test (IOD + SIN + EMI) _____ (40)

Explanation of Procedures Used to Obtain Scale Scores from Raw Scores

On each of the four tests on which you marked any responses, the total number of correct responses yields a raw score. Use the table below to convert your raw scores to scale scores. For each test, locate and circle your raw score or the range of raw scores that includes it in the table below. Then, read across to either outside column of the table and circle the scale score that corresponds to that raw score. As you determine your scale scores, enter them in the blanks provided on the right. The highest possible scale score for each test is 36. The lowest possible scale score for any test on which you marked any responses is 1.

Next, compute the Composite score by averaging the four scale scores. To do this, add your four scale scores and divide the sum by 4. If the resulting number ends in a fraction, round it off to the nearest whole number. (Round down any fraction less than one-half; round up any fraction that is one-half or more.) Enter this number in the blank. This is your Composite score. The highest possible Composite score is 36. The lowest possible Composite score is 1.

ACT Test A10	Your Scale Score
English	_____
Mathematics	_____
Reading	_____
Science	_____
Sum of scores	_____
Composite score (sum ÷ 4)	_____

NOTE: If you left a test completely blank and marked no items, do not list a scale score for that test. If any test was completely blank, do not calculate a Composite score.

Scale Score	Raw Scores				Scale Score
	Test 1 English	Test 2 Mathematics	Test 3 Reading	Test 4 Science	
36	73-75	59-60	39-40	39-40	**36**
35	71-72	56-58	38	38	**35**
34	70	54-55	37	37	**34**
33	69	53	36	36	**33**
32	68	52	34-35	35	**32**
31	67	50-51	33	34	**31**
30	66	49	32	—	**30**
29	65	47-48	31	33	**29**
28	64	44-46	30	32	**28**
27	62-63	42-43	29	31	**27**
26	61	39-41	28	30	**26**
25	58-60	37-38	27	28-29	**25**
24	55-57	35-36	26	27	**24**
23	52-54	33-34	24-25	25-26	**23**
22	50-51	31-32	23	24	**22**
21	47-49	30	21-22	22-23	**21**
20	44-46	28-29	20	21	**20**
19	42-43	26-27	19	19-20	**19**
18	40-41	24-25	17-18	18	**18**
17	38-39	20-23	16	16-17	**17**
16	35-37	17-19	15	15	**16**
15	32-34	13-16	13-14	13-14	**15**
14	29-31	10-12	12	12	**14**
13	26-28	8-9	11	10-11	**13**
12	24-25	6-7	9-10	9	**12**
11	21-23	5	8	8	**11**
10	17-20	4	7	7	**10**
9	15-16	—	6	6	**9**
8	13-14	3	5	5	**8**
7	10-12	—	4	4	**7**
6	8-9	2	—	3	**6**
5	6-7	—	3	—	**5**
4	5	1	2	2	**4**
3	3-4	—	—	1	**3**
2	2	—	1	—	**2**
1	0-1	0	0	0	**1**